

Orbit

September / October 1980

The Journal of the Radio Amateur Space Program



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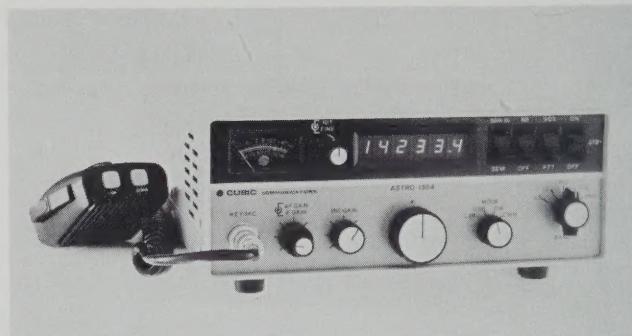
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Our Cover: See page 35.



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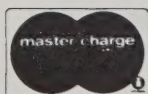
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Editorial

By Joe Kasser,* G3ZCZ/W3

AMSAT Finds a New Home

AMSAT now has a new home in Silver Spring, Maryland. Leaving Seventh Street in Washington, we spent a few weeks in temporary quarters in Greenbelt, Maryland. The office is now located at 850 Sligo Avenue Suite 201A in Silver Spring. The office is located diagonally across from the Silver Spring Greyhound Bus terminal, a few blocks from the Silver Spring Metro Station.

Any member visiting Washington, D.C. is welcome to drop in at the office for a visit. Martha will be pleased to meet you and may even provide a cup of coffee.

Boosting the Magazine

Currently, *ORBIT* is running at 40 pages per issue. We would like to increase that to 48 or even 64 pages. AMSAT has a limited budget for *ORBIT*. In order to increase the size of the magazine, the extra cost must be paid for by advertising. In order to attract more advertisers, we need to have a larger circulation. One way of increasing the circulation is to make the magazine available at Radio or Computer stores.

You, as a member can help. If you show your copy of *ORBIT* to the magazine/book manager at your local store, you will be able to interest the store in taking a consignment on a sale-or-return basis. A sale-or-return basis means that the costs to the store are negligible. All it supplies is shelf space. You can act as the agent on behalf of AMSAT/*ORBIT*. Try it, then contact the Distribution Department and let us know how many copies to send you. Random sales of the magazine from stores, increase the circulation and generate new memberships which will have the direct result of enabling us to increase the number of articles in your magazine.

Bob Poole, AJ6F (left) President of the Hughs Aircraft Company El Segundo Division Amateur Radio Club, presents a \$100 check to AMSAT. The presentation was made at the July meeting which featured Norm Chalfin, K6PGX, as the speaker. Norm is shown at the right.

Back Issues

Did you miss one of the early issues of *ORBIT*? There are a few of these collector copies left. Send \$3 for issue one or two, \$5 for both to cover the magazines plus postage. Also there are back issues of the award winning *AMSAT Newsletter*. Most issues from 1974 through 1979 are available. We'll send you fifteen copies of the most popular issues for \$10 postpaid. Send to *ORBIT* 221 Long Swamp Road, Wolcott, CT 06716.

Payload Retrieval

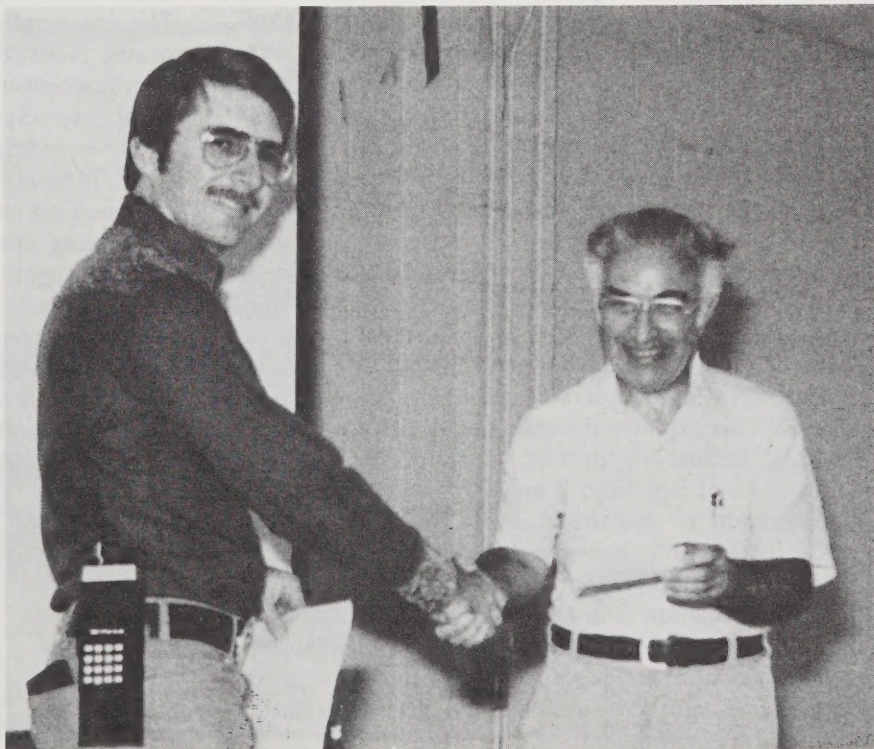
ORBIT Magazine is written by the members of AMSAT for the members of AMSAT as well as for anyone else interested in the Radio Amateur Space Program. The contents of the Journal reflect the submissions of material. If you like, or dislike something, or would like to see an article on a particular topic, please use the Payload Retrieval coupon (or a facsimile thereof) to let us know. We usually hear from people who dislike something, and will thus tend to respond to them and make changes. If you like something, it is important that you let us know too, so that your comments balance theirs.

The Membership Computer Returns

The AMSAT-GOLEM-80 computer finally came back from the launch site and is now available for use in the office. We are thus getting the membership list under control and catching up on the paperwork. Two office moves in a period of one month also contributed to the confusion. We are now back on line and catching up fast. Martha, operating at 120% efficiency, is the only member of the headquarters office staff and is doing her best to catch up with the renewals, new memberships, conversions to life membership, etc. There are times when the new office is knee deep in outgoing mail. Thank you for being patient. We expect that things will be operating at their new level of efficiency before the annual meeting.

Satellite QSL Cards

We've had many requests for satellite related QSL card designs. We are showing a few examples in this issue. If you have a unique card and would like us to consider it for publication, send it to *ORBIT* QSL, 850 Sligo Ave., Silver Spring, MD 20910.



The Satellite Program

Where do we go from here?

By Joe Kasser,* G3ZCZ

The failure of the AMSAT Phase IIIA spacecraft, to take its place in history as AMSAT—OSCAR 9 does not portend the end of the OSCAR series of spacecraft. Even now, around the world, no fewer than four new spacecraft are in various stages of construction. These satellites have the potential to offer new and exciting vistas in the field of the Amateur Satellite Service.

Plans are being made, and hardware is being assembled in Canada, France, the Federal Republic of Germany, Italy, Japan, the Soviet Union, the United Kingdom and in the United States. Here we present an introduction to these activities.

AMSAT - OSCAR 7 and 8: The Operational Satellites

For the immediate future, the AMSAT-OSCAR's 7 and 8 will remain the active spacecraft. Recent battery tests on AMSAT-OSCAR 8 have shown that the battery is in reasonable shape and the satellite has the potential for a long and useful life. As of early August, AMSAT-OSCAR 7 continues to operate as the oldest active radio amateur satellite. November will mark the sixth anniversary of its launch. Designed for a three-year lifetime, it continues to provide the means for satellite communications for hundreds of radio amateurs despite being plagued by the problems of advancing old age. The last good telemetry data gathered indicates at least one of the string of battery cells has failed in the *open state*. Consequently the solar cells are unable to charge the battery. This results in AMSAT-OSCAR 7 only operating when its solar arrays are in sunlight. If it passes within the earth's shadow, even for a short period of time, the transponder shuts down, and the mode control logic seems to reset the satellite into Mode B. This explains the reason why the satellite has remained exclusively in this mode for the last few months. As of late July, it now appears to be in complete sunlight so that the on-board 24-hour clock can switch the satellite between Modes A and B. This premise has not yet been confirmed. The default telemetry modulation is low level AFSK RTTY, which is difficult to copy. Some of the CMOS in the telemetry encoder has malfunctioned because of the degeneration of the devices caused by accumulated doses of radiation in its orbital environment.

UOSAT: A Satellite for Science

The next candidate for the title of AMSAT-OSCAR 9 is the UOSAT currently under construction as a joint AMSAT-UK—University of Surrey project at the University of Surrey in England. UOSAT is, at this time, scheduled for launch aboard a Delta vehicle as a secondary payload on the Solar Mesosphere Explorer mission, in September, 1981. This spacecraft is the first Amateur Scientific Satellite and does not contain a communications transponder. It is aimed at the AMSAT Educational Program and as a tool for serious research and study of radio propagation phenomena. The spacecraft will be put into a sun-synchronous orbit with an altitude of 530 km, at an inclination of 97.53 degrees. The sun-synchronous orbit will have three P.M. descending node, that is, its descending node overhead pass will always occur at about three P.M. The period of the orbit is 98 minutes.

UOSAT will contain coherent beacons in the 7-, 14-, 21-, and 28-MHz bands as well as VHF/UHF beacons in the 145-, 435-MHz and 2.4- and 10.47-GHz bands. The spacecraft will be controlled by an on board integrated Housekeeping Unit (IHU) built around an 1802 microprocessor. UOSAT will also carry three experiments, namely a particle detector, a magnetometer and a slow-scan television camera.

An integrated circuit manufactured by ITT, designed for speaking clocks is being evaluated for suitability in generating speech telemetry. The integrated circuit has the capability to generate numbers from 1 to 59, and versions are available in English, French and German. Should this device prove suitable, the spacecraft will be sending back telemetry as plain language voice signals.

The telemetry is planned to have the capability of being transmitted in the following formats and rates:

ASCII	1200 bauds
	600 bauds
	300 bauds
	110 bauds
BAUDOT	50 bauds
MORSE	10 wpm CW
VOICE	

*Editor, ORBIT Magazine

The Slow-Scan TV signals have been simulated using weather satellite pictures (see Fig. 1). The signals will be transmitted in *digital format* rather than in conventional analog SSTV because the camera is digital based on charge-coupled devices. The data is designed to be put into a computer and/or displayed on a fast scan or regular TV monitor, which requires digital storage of the data.

With the launch of this spacecraft, a new realm of experimentation will open up for the radio amateur.

The Canadian Program

AMSAT-Canada started as a Canadian group acting on behalf of AMSAT nearly seven years ago. Canadian amateurs have been active participants in the construction of, and providing ground commanding for OSCARs 6, 7 and 8. In fact, Larry Kayser, VE3QB, and Randy Smith, VE1SAT, (formerly VE3SAT and VE2BYG) were each for a time prime ground stations in the AMSAT-telemetry-tracking-and-control network. With the start up of a design and project group in Ottawa in early 1978, a package for synchronous or near synchronous orbit where the transponder would be part of a host vehicle has been their specific assignment. The project has had various names, including the NASA defined "SYNCART", which means *Synchronous Amateur Radio Transponder*.

It is designed as a transponder to fly on a host vehicle operating in a geostationary orbit (or as near as possible) where it will always depend upon the host for power, environmental and structure.

Fig. 2 shows the transponder configuration outline. Note that no specific design information is given on the input or output frequencies as this could vary. Specifically, the design hopes to use a 1261.6-MHz

input center frequency and 435.6-MHz output center frequency. The uplink is projected at 1-kW EIRP (*i.e.* 10 watts to a four-foot 1.2-M mesh dish) with downlink receive ability requiring a 1.5-dB noise figure and 10-dB antenna gain. These are just design areas so as to realize the interface to the amateur and resultant system configuration.

The i-f amplifier uses two four-pole 30-MHz crystal filters, BW=100 kHz, manufactured by Piezo. The present design is achieving 90 dB of gain, only six dB short of the design goal and is completely stable. Other narrower band filters may be included to provide organization traffic; ARRL, AMSAT etc., and most likely a digital channel with microprocessor interface.

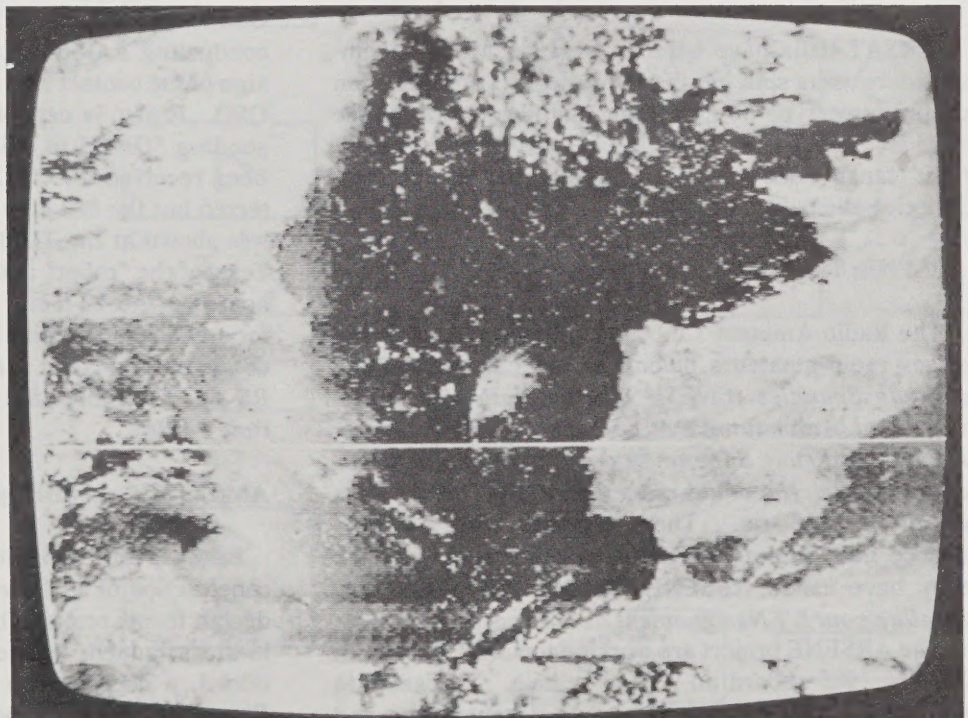
The upconverter design has a fast acting ACG compression that will stop pulse signals from saturating the transmit linear amplifier. Realizing the small amount of power available, the design will stay below the 10-watt PEP design until more dc power appears permissible.

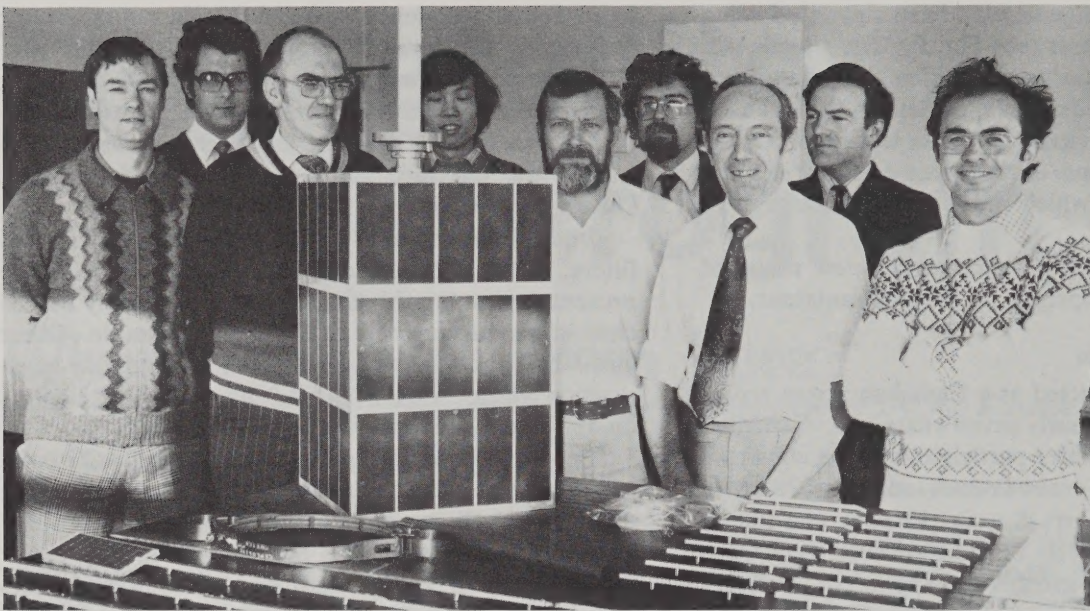
The microprocessor is a CMOS 1802 design, completely redundant and self-checking. The CPU would handle the basic operation and housekeeping chores and provide a steady stream of transponder measurements and status to the ground command stations. The Telemetry format for the downlink is still to be defined.

The power processor contains: a current limiter, series voltage regulator, shunt-over-voltage protection circuit and double dc-to-dc converters.

In all AMSAT-Canada, Ottawa Project Group, has quietly undertaken over the past two years, to consider the trade-off and designs that would be suitable for use in a long-life geostationary transponder mission on behalf of Radio Amateurs everywhere.

Fig. 1 -- A preliminary simulation of the proposed UOSAT image data using TIROS-N with 256 by 256 pixels and 16 gray levels displayed on an eleven-inch domestic TV screen. The image shows clearly Africa, Spain, the coasts of France and southeastern England. The gray area on the left is sun reflection from the surface of the Atlantic Ocean.





Part of the
UOSAT Team at
The University of
Surrey, England.

Meanwhile, In Japan. . . .

JAMSAT, who gave Mode-J to the world, are again at work on a mode M transponder. It will have an uplink at 1260 MHz and a downlink at 435 MHz. Designs have been breadboarded. The flight version of the transponder possibly could be flown on a Phase IIIB satellite or any other available spaceframe. JAMSAT have been active in the satellite program for a number of years, designing and building the Mode-J transponder operating aboard the AMSAT-OSCAR 8 spacecraft, and supplying the passband filter used in the Mode-B transponder aboard the late Phase IIIA satellite.

And In Italy. . . .

AMSAT-Italia have been at work on Mode-A transponders using split passband i-f stages. A description of their prototype by ISTDJ was published in the June 1978 issue of the *AMSAT Newsletter*. Prototypes of their transponder have been flight tested aboard ionospheric balloons.

ARSENE: The French Satellite

The Radio-Amateur Club de L'Espace (RACE) comprises radio amateurs belong to the *Centre National d'Etude Spatiales (CNES)*, *L'Ecole Nationale Supérieure de L'Aeronautique et de L'Espace*, at Toulouse, *L'Ecole Nationale Supérieure des Telecommunications* and *L'Ecole Nationale Supérieure des Techniques avancées* in Paris. They, together with AMSAT-France have formed a French satellite project which they have called ARSENE; *Ariane, Radio-Amateur, Satellite pour L'Enseignement de L'Espace*.

The ARSENE project are working toward a launch, in 1984 or 1985 aboard an Ariane vehicle. The satellite will carry a 10-GHz beacon, a Mode-B transponder and

a new mode; a transponder having an uplink in the 1260-MHz band and a downlink at 2.4 GHz. This transponder (which will probably become known as Mode-F) will have a passband 10-MHz wide.

In The Soviet Union. . . .

The successful operation of Radio-1 and Radio-2 means that their creators, enthusiasts from the DOSAAF Volunteer Space Technology Laboratory, (*Obshchestvennaya Laboratoriya Kosmicheskoy Tekhniki (OLKT) DOSAAF SSSR*) are again working on a spacecraft. The windows of the OLKT are lit up late at night while new equipment is being perfected. One item, is an automatic operator or "robot", developed by Alexander Papkov. This robot, as described by Pat Gowen in the June/July issue of *ORBIT*, is capable of conducting a QSO, acknowledging receipt of the call sign of the contact and assigning a serial number to the QSO. It also is capable of detecting interference and sending "QRM" to indicate that your call sign has not been received, or "QRZ", meaning that a call was detected but the call sign was not received. The "robot" was shown at the TELECOM-79 exposition in Geneva. Tests of the "robot" and transponders have been widely heard on the 10-meter downlink. Launch information for any Soviet satellite is difficult, if not impossible, to obtain but the latest rumors estimate that the launch of RS-3 and possibly RS-4 will occur not in 1980, but some time in 1981.

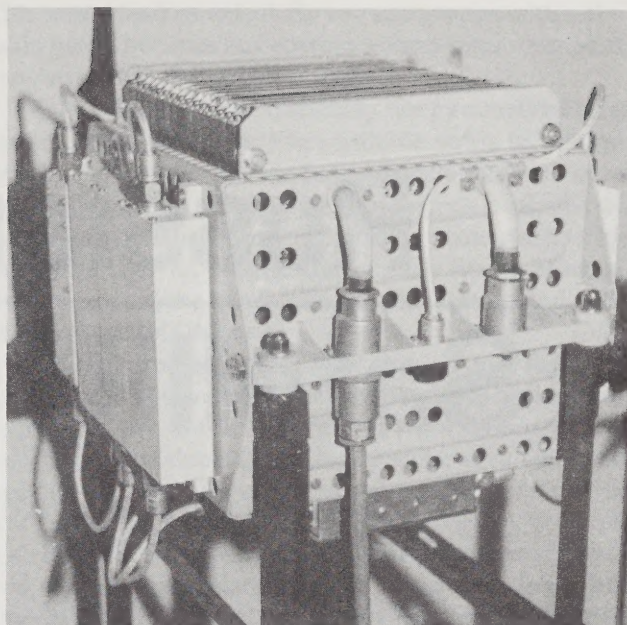
AMSAT's Phase IIIB Spacecraft

Lastly, AMSAT is determined to press on with the construction of a Phase IIIB spacecraft. The Phase III design teams remains in tact. Efforts are underway to locate a launch vehicle, and once that has been obtained, a decision can be made as to what form the Phase IIIB spacecraft will take. Of course, as much use

RS-3, the Soviet built spacecraft was on display in Geneva early last Fall. Note that the approach to hardware design is different than we have seen with OSCAR satellites. RS-3 has some very unique features, such as a receiving and transmitting 'robot.' See the text for more details.

as possible will be made of the knowledge, technology and hardware already in existence. It is expected at this time that no matter what form Phase IIIB takes, its launch will be in the 1983-1984 time frame.

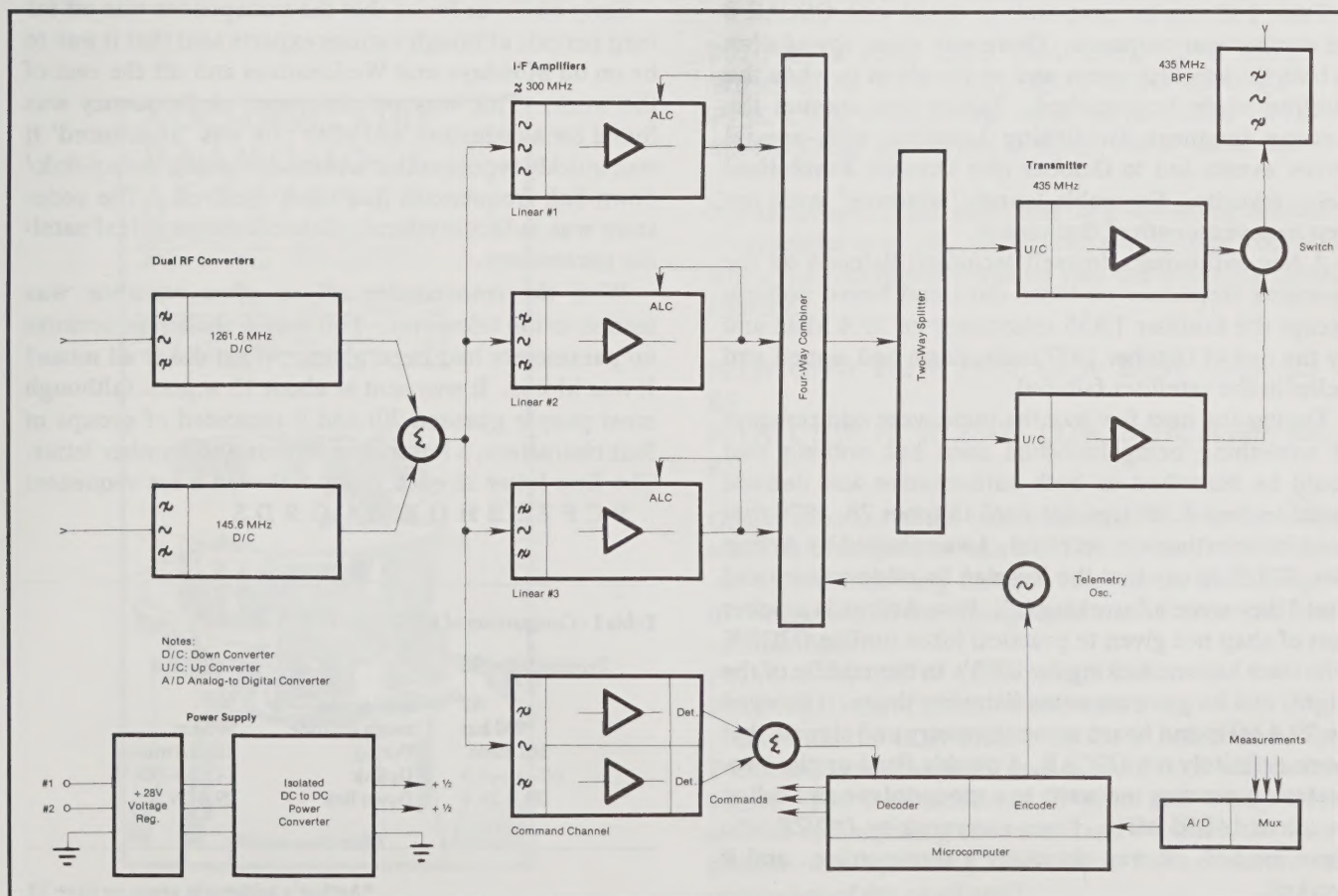
Phase IIIA failed to achieve its place in history. The advance of the Amateur Satellite Service from experimental to the operational stage was thus postponed for a few years. Several groups worldwide are working on new spacecraft, and you can be sure that further details of them and their potential will be published right here in *ORBIT* Magazine.



Acknowledgements

The author wishes to express thanks for the contributions made by F8ZS, G3YJO, HB9BRQ, K1HTV, VE2VQ, *Radio* and *Ondes Courtes Informations* Magazines for some of the material presented here.

Fig. 2 -- The Canadian SYNCART Transponder configuration.



Russian Satellites

By Terry Weatherby,* G3WDI



In the late summer of 1977 a circular was issued by the International Frequency Registration Board, an organization of the ITU. This circular gave the first details of a planned amateur satellite network to be established by the USSR:

"The system 'RS' would be based on 3-4 satellites on a circular near polar orbit. The amateur satellite stations are designed for multiple access, with retransmission and frequency translation without demodulation on a real time scale."

Table I shows the proposals in detail with OSCAR 8 for comparison purposes. There was some speculation in both the amateur press and on the air as to when the satellite might be launched. Taking into account the Russian fondness for linking launches with special Soviet events led to October (the October Revolution) being favorite. Favorable launch 'windows' were the first or seventeenth of that month.

A few enthusiasts (myself included) listened on the downlink frequency on those days and heard nothing except the familiar TASS teleprinter on 29.4 MHz and by the end of October 1977 enthusiasm had waned and belief in the satellites faltered.

During the next few months there were odd rumours of something being launched soon but nothing that could be described as both authoritative and definite could be found. It was not until October 28, 1978 that hard information was received. I was phoned by Arthur Gee G2UK to say that the Russian Satellite was up and that "they were all working it". Now Arthur is a sober sort of chap not given to practical jokes (unlike G3GNK who once had me looking for UFO's in the middle of the night) and he gave me some listening times. I listened on 29.4 MHz and heard some telemetry and signals that were definitely not OSCAR. I quickly fired up the two-meter rig running ten watts to a groundplane and called on about 145.95 MHz. I was answered by DC9ZP who gave me 5/3. It was obviously a transponder...and it worked.

By monitoring the frequency, it was established that the orbit period was about 120 minutes which placed the satellite in a high orbit and it was this figure that was used to calculate future orbits. In the ensuing days it was brought home to the author the need for a really accurate orbit time. One minute per orbit is 12 minutes error a day and 84 minutes in a week. Very soon one can be listening at the wrong time, hear nothing, and give up. Similarly the satellite's equatorial crossing slips.

Early on it was found that the transponder was off for long periods although various experts said that it was to be on on Mondays and Wednesdays and off the rest of the week. This was not the case. A frequency was found for a codestore and after this was 'announced' it was quickly reported that a message giving the up-link/down-link frequencies had been received. The code-store was in fact mythical. Table II shows actual satellite parameters.

With the transponder off so often attention was turned to the telemetry. This was a challenge because no parameters had been given. What did it all mean? It was Morse. It was sent at about 15 w.p.m. (although most people guessed 20) and it consisted of groups of four characters, a letter, two figures and another letter. The first letter in each group followed a set sequence:

P C F Z L B H O W K U G R D S

Table I - Comparison of OSCAR and RS.

Proposals for RS		OSCAR 8
82°	Inclination	99°
950 km	mean altitude	905 km
102 mins.	Period	103.13 mins.
145.8-145.9	Uplink	145.85-145.95
29.3-29.4	Down link	29.4-29.5

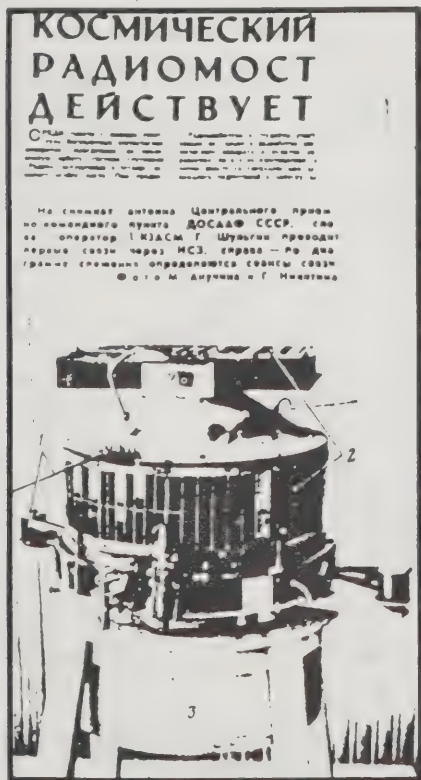
*Author's address is given on page 32.

Shown here and elsewhere on these pages are some of the newspaper clippings found in the Soviet Press.



This seemed like a random series of letters but Geoffrey Perry of Kettering School, well experienced in Russian Satellite telemetry techniques pointed out a binary relationship. He suggested substituting O for a dot and 1 for a dash. Reading the resultant binary number right to left we find:

P	..-	0110	=	6
C	-. .	1010	=	5
F		0010	=	4
Z	-. . .	1100	=	3
L		0100	=	2
B	-. . .	1000	=	1
H		0000	=	0
O		111	=	7
W	..-	011	=	6
K	-. .	101	=	5
U	..-	001	=	4
G	..-	110	=	3
R	..-	010	=	2
D	-. .	100	=	1
S		000	=	0



This would lead us to look for two sub groups within the main group because on occasion a short frame was sent consisting of P C F Z L B H only.

The two figures were obviously the parameter being measured the prefix together with the suffix indicating which of the channels was being transmitted. To sum up we thus had a telemetry system which consisted of two fifteen channel sequences being distinguished by the suffix U or K. At the end of each fifteen channel frame was sent the two letters RS which compared with the HI of the OSCAR series.

While waiting for a possible pass on ten meters I heard two W's discussing the new satellites saying that there were two of them in orbit. I reported this locally but it was explained to me that people were confused because the satellite sometimes sent RS RS instead of RS. It was reported to me the following day that the tracking station in Slough had tracked three objects, two of which were satellites. It was at this time that Pravda reported that two Radio Sputniks had been launched in a spirit of peace friendship.

The telemetry was still very intriguing and Peter Greed, G3MQD, started to collect sets of telemetry from each pass. In all he managed to collect 80 sets of data from the first 350 orbits. Lets now look at a typical set of data as transcribed:

P01U C17U F34U Z33U L81U B45U H37U O15U
W41U K01U U37U G01U R17U D01U S49U RS
P73K C73K F72K Z73K L01K B31K H50K O37K
W50K K05K U42K G32K R46K D01K S40K RS

P01U C17U F34U Z32U L83U B45U H37U O07U
W08U K07U U11U G01U R17U D01U S27U RS
P73K C73K F72K Z73K L01K B31K H38K O01K
W04K K05K U38K G01K R07K D07K S23K RS

It was observed that while this data was being sent the transponder was off. A typical set of data received when the transponder was on was the following (short frame):

P01W C99W F61W Z57W L82W B45W H38W RS
RS
P01W C77W F57W Z54W L82W B45W H38W RS
RS

Observation led to the conclusion that W was the suffix when the transponder was on. This seemed to be borne out by the following frame where the suffix changed in the frame and the transponder was off from the time of transition:

P01W C99W Z57W L82W B45U H38U RS
P01U C01U Z57U L82U B45U H38U RS

But what did it all Mean? In the U suffix mode the P channel was always 01 thus it could be a calibration signal. The C channel was 01 when the transponder was off and anything between 1 and 99 when the transponder was operating. Could it be a measure of occupancy of the passband?

It was not long however before details of the telemetry were available. Figure 1 shows how it was initially understood.

There was another interesting feature to the telemetry which was first heard on November 8. The Morse telemetry was replaced by what was described as a 'frying noise' which later proved to be high-speed telemetry.

Subsequently we fed the high-speed telemetry into a pen recorder running at 480mm/second. The trace is displayed in Figure 2. Further details of this telemetry were given in *Radio No 1*, 1979 which described the telemetry system as having a capacity of 256 bits at a rate of 50 baud. It contained a fixed frame sent to ascertain the number of errors that can occur when high-speed data is sent from space. Details of the decode equations for the normal telemetry were also given and a better translation for channel 21 was given as the battery charge regulator temperature.

Both satellites seemed to develop battery trouble and nothing has been heard from them for some time. It has been reported that they were used briefly by a Soviet expedition to the North Pole. Ground testing of RS3 has been heard in the UK and a launch is now expected in 1981.

Satellites are fun and it is interesting to decode telemetry. It can also become habit forming so that one spends all the pass listening to the telemetry rather than the DX. If you like a challenge, listen to any satellite telemetry and try to decode it without reading the AMSAT decode charts first.

The data for this article was gleaned from many sources:

"An initial look at the RS telemetry," Peter Greed, G3MQD, *Radio Communication*, Feb. 79.

AMSAT Newsletters, since the launch date.

"Satellite observation Notes," *Science Research Council*, Nov. 78.

OSCAR News, AMSAT UK, various issues since launch

Fig. 1 - Telemetry channels for the RS Satellite.

Letter	Channel	Parameter
P	01	Calibration signal
C	02	Repeater rf out.
F	03	Transmitter temp.
Z	04	Telemetry equipment temp.
L	05	Power supply voltage
B	06	9-volt regulated voltage
H	07	7.6-volt regulated voltage
O	08	No. 1 solar panel
W	09	No. 2 solar panel
K	10	No. 3 solar panel
U	11	No. 4 solar panel
G	12	Calibration signal
R	13	rf out.
D	14	Ground
S	15	Battery charge current
P	16	Battery 1 volts
C	17	Battery 2 volts
F	18	Battery 3 volts
Z	19	Battery 4 volts
L	20	Calibration signal
B	21	Battery switch unit temp.
H	22	Battery charge current
O	23	No. 1 solar panel
W	24	No. 2 solar panel
K	25	No. 3 solar panel
U	26	No. 4 solar panel
G	27	No. 1 solar panel
R	28	No. 2 solar panel
D	29	No. 3 solar panel
S	30	No. 4 solar panel

Table II - Actual operating parameters for RS

Period	120.39041 mins.
Increment	30.227 degrees
mean altitude	1706 km
inclination	82°
uplink	145.87-145.915
Down link	29.350-29.395

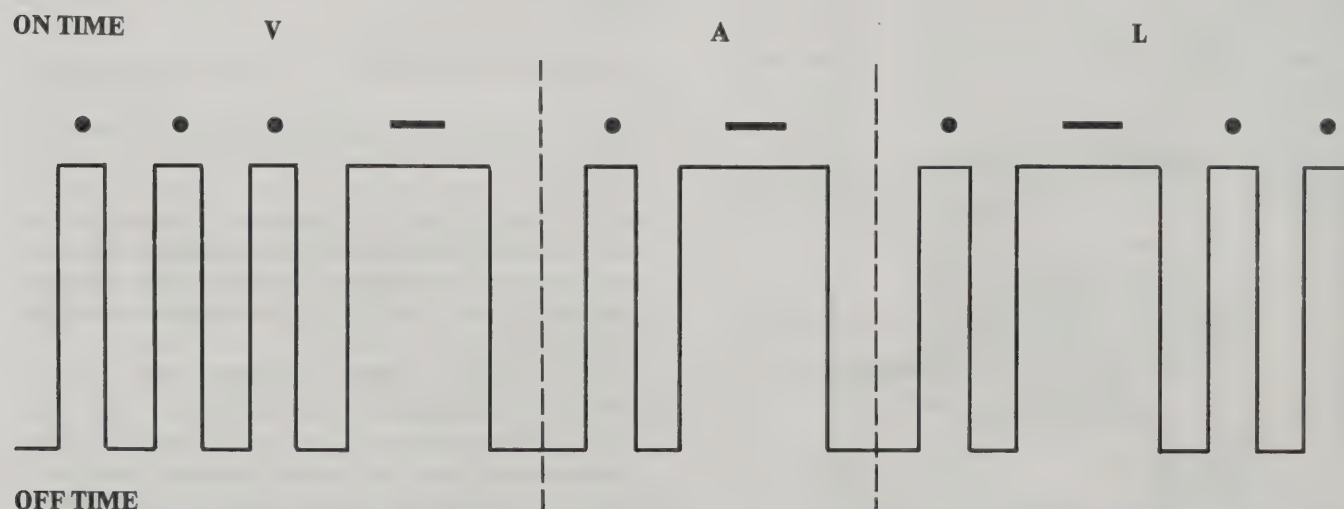


Fig. 2 - Part of the high-speed telemetry frame from RS-1. Pen recorder at 480 mm/sec.

AMSAT-DL TECHNICAL CONTRIBUTIONS TO PHASE IIIA



By Alexander Schoening, DC7AS

Am 18. April 1980 wurde der Amateurfunksatellit AMSAT-OSCAR 9 von Marburg nach Kourou versandt. Einige Tage später, am 23.4., trat das AMSAT-DL-Techniker-Team, bestehend aus Dr. Karl Meinzer, DJ4ZC/FYØESZ, Werner Haas, DJ5KQ/FYØESE, Ulrich Müller, DK4VW, und Techniker Konrad Müller, die Reise nach Französisch Guayana an. Sie treffen dort Jan King, W3GEY, Clarke Greene, K1JX, Dick Daniels, W4PUJ, und Technikerin Marie Marr von der AMSAT-USA. Außerdem wurden von der AMSAT-DL noch Hilfs- und Prüfgeräte im Gewicht von etwa einer halben Tonne nach Kourou verfrachtet. Weitere 300 kg bringen die Amerikaner mit, dazu auch das Zusatztriebwerk, das erst in Kourou montiert wird.

Mit der Abreise nach Kourou war die Phase der Entwicklung und der Fertigung von AMSAT-OSCAR 9 abgeschlossen. Sie begann eigentlich schon 1973, als Dr. Karl Meinzer, DJ4ZC, einem Technischen Symposium der ARRL die ersten Pläne für einen Amateurfunksatelliten auf einer elliptischen Umlaufbahn vorlegte.

Schon damals begann sich abzuzeichnen, daß es beim „AMSAT-Phase-3-Projekt“ nicht mehr nach dem alten Rezept „Fliegendes Relais mit Zubehör“ abgehen konnte. Zum Erreichen der angestrebten elliptischen Umlaufbahn war ein Zusatztriebwerk erforderlich, und dadurch stellten sich dem Marburger Entwicklungsteam zusätzliche Aufgaben, die durch die Stichworte „Lagebestim-

ung und Lageregelung des Satelliten“ nur grob umrissen werden. Hinter diesen Stichworten verbarg sich nämlich die Notwendigkeit zur Entwicklung neuer, hauptsächlich elektronischer Baugruppen, für die es bisher bei Amateurfunksatelliten keine Vorbilder gab. Der von AMSAT-DL entwickelte Satellit enthält deshalb erstmalig Baugruppen wie Sonnen- und Erdsensoren mit der dazugehörigen Sensor-Elektronik, eine Motor-Zündeinheit, einen Bordcomputer sowie einen Nutationsdämpfer zur Unterdrückung unerwünschter Eigenbewegungen des Satelliten. Schließlich entwickelte Dr. Meinzer „ganz nebenbei“ noch die Programmsprache „IPS“, in der er sich mit seinem Kind nach dem Start des Satelliten in Kourou unterhalten wird.

AMSAT-OSCAR 9 spricht also deutsch. Er ist auch der erste Amateurfunksatellit, der eine Lizenz der Deutschen Bundespost erhalten hat. Am 22.2.80 wurde ihm das Rufzeichen DFØOS zugeteilt.

Aus der vorstehenden Schilderung geht hervor, daß der Transponder, einst das dominierende Herzstück der Bordelektronik, nun nur noch eine der zahlreichen Baugruppen des Satelliten ist. Dies erkennt man auch, wenn man einen Blick auf die Abbildung wirft. Dieses „Blockschaltbild“ ist nicht mit den Augen des Elektronikers zu betrachten. Es zeigt vielmehr die Verkettenung der einzelnen elektronischen und mechanischen Baugruppen an Bord des Satelliten, nennt ihre Bezeichnungen (international üblich) in englischer Sprache kanischen Freunde beim Bau des 1802-Computers und der Motor-Zündeinheit gelegen haben dürfte. Zwei Baugruppen, nämlich Feststoff-Triebwerk und Batterien, betreffen Zulieferungen von Industrienerzeugnissen. Bei der Baugruppe „Clampband“ handelt es sich um ein Stahl-Spannband zur Halterung des Satelliten und „Harness“ bedeutet Kabelbaumherstellung und Verdrahtung.

Neu ist die Beteiligung ungarischer Funkamateure von der Universität in Budapest unter der Leitung von Dr. A. Gschwindt, HA5WH. Sie stellten den Batterie-Laderegler her, der (wie auch die Abbildung zeigt) eine entscheidende Position in der Funktionskette aller Baugruppen einnimmt. Die Herstellung dieser Baugruppe, die sich übrigens bei allen Tests hervorragend bewährte, geht auf einen förmlichen Kooperationsvertrag zwischen der Hungarian Amateur Radio Society (MRASZ) und AMSAT-DL vom 23.2.1979 zurück.

Nicht in der Abbildung darstellbar sind schließlich die zahlreichen Management-Tätigkeiten, die im Laufe der Zeit auf AMSAT-DL als Projektentwickler zukamen. Dazu gehören die Verhandlungen mit der ESA, die Wahrnehmung der von der ESA geforderten Tests, zahlreiche Reisen zu Koordinationsgesprächen im In- und Ausland, die Erarbeitung der erforderlichen Dokumentationen, die Lizenzierung und vieles andere mehr. Alle diese Arbeiten haben einen erheblichen Aufwand von Zeit und Geduld, aber auch den Einsatz mancher Finanzmittel erfordert.

Auf alles Geleistete dürfen wir wohl stolz sein. Hoffen wir, daß es sich gelohnt hat!

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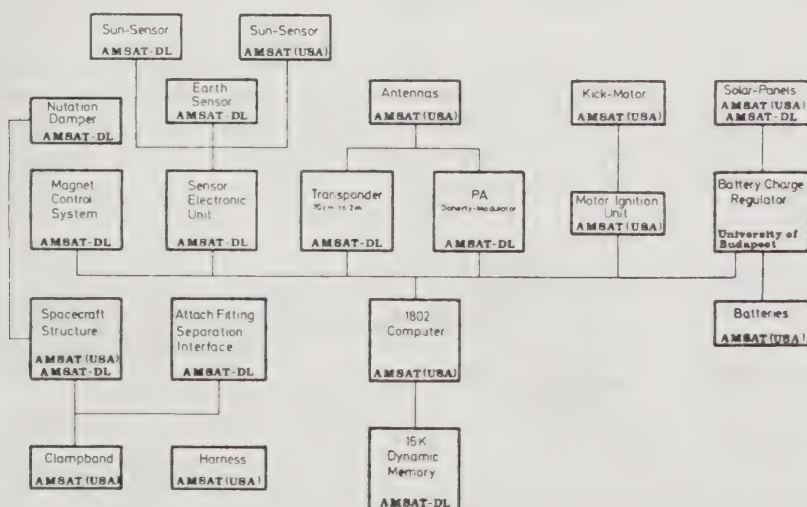
Auf alles Geleistete dürfen wir wohl stolz sein. Hoffen wir, daß es sich gelohnt hat!

Transponder-Frequenzen

Satellit und Mode	Uplink (MHz)	Downlink (MHz)	Baken (MHz)
AMSAT-OSCAR 7			
Mode A	145,850–145,950	29,400–29,500	29,502
Mode B	432,125–432,175	145,975–145,925	145,972
AMSAT-OSCAR 8			
Mode A	145,850–145,950	29,400–29,500	29,402
Mode J	145,900–146,00	435,100–435,200	435,095

Transponder-Betriebszeiten

AMSAT-OSCAR 8	
Montag und Donnerstag:	Mode A
Dienstag und Freitag:	Mode A und Mode J
Samstag und Sonntag:	Mode J
Mittwoch:	kein QSO-Betrieb!
Kurzfristige Änderungen sind möglich.	





The Third Generation

By Jan King,* W3GEY

PART-I

A two-part series describes the men and their engineering philosophy as it relates to the Phase III Satellite Program. Amateur Radio has made a number of unique and significant developments in space hardware technology. Let these achievements be documented!

All of the Problems were Solved. . . We Think!

Please look closely at the photograph. It's one of the best photos we have from our collection of Phase IIIA pictures. It's all the more attractive if you've just spent five years imagining it, creating it, sweating over it and hoping that it will provide services to thousands of people. Our "space machine" when last heard from functioned even better than it looked! Not only were the electronics performing perfectly, but I am convinced we had thought of and coped with every problem that could beset a spacecraft. All but one, that is. That, to me is the most frustrating thing about the loss of Phase IIIA. Did we have successful solutions to all these problems? We cannot know for sure until we do it all over again. And then we will have the same uncertainties and the same risks. Shall we do it again? Hell Yes!

Phase IIIA - The Loss

In manpower and dollars its easy enough to state what was lost. Elsewhere in this issue of *ORBIT* is a complete digest of the financial position for Phase IIIA by W3IWI entitled "Spacecraft Economics." A summary is appropriate here:

Organization	Man Power	Funds
AMSAT & AMSAT Canada	15 years	\$210,000
AMSAT-DL	15 years*	\$150,000*
HG5BME et. al.	2 years*	?
JAMSAT	?	\$5000

*Estimate

*Vice-President, Engineering, AMSAT

This is a bit more than our earlier estimates. There was also \$30,000 in expenses paid by the hard core of constructors themselves for which they asked no repayment. In addition industrial hardware contributions amounted to about \$200,000.

As you no doubt have surmised, the real damage of the Phase IIIA loss is to the people; those who built the machine as well as those who had hoped to use it. I was touched by the number of people who wrote me and described how the launch failure had ruined their weekend. John, WØLER, told me that when his wife learned of the failure, "she just sat down and bawled." Betty spent many hours helping John fabricate printed-circuit boards in order to have the AMSAT command station receivers ready for the launch. There are many personal stories to tell about the first five years of Phase III. I hope somehow there will be a place and a time to tell them. Since the future cares little for the agonies of the past, we must now close the Phase IIIA book and continue onward.

Phase III - The Technology

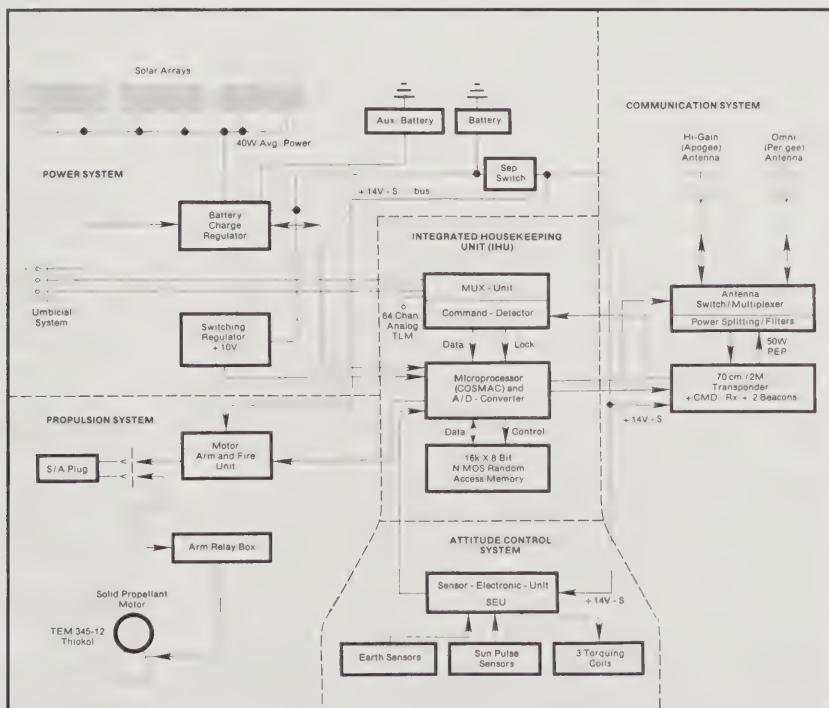
While a number of user articles have appeared in print on varying facets of Phase III, virtually nothing has been published which describes the entire scope of the Phase III technology. This is our objective here.

An amazing amount of new and creative technology was developed for Phase III. Much of it is patentable. This technology was created for Amateur Radio and was essential because of the unique problems posed by amateur stations using a spacecraft. I will elaborate on these by example. Table 1 is a summary of all of the new techniques used on Phase III. While some of these are new only to the amateur satellite program, those

indicated by an asterick * are thought to be entirely novel to the aerospace field. To a certain extent many of our practices and techniques are orthogonal to the commercial approach in the sense that they solve a different set of problems; problems that industry has no need to solve. On the other hand some of the hardware developed for Phase III is directly applicable. It is mandatory that this work be published and made available to industry so that Amateur Radio is properly credited. Now is the time frame in which this work must be done.

If you compare the final block diagram of the spacecraft (Fig. 1) with earlier versions I authored in *QST*¹, you will notice that we followed closely our design goals. It is evident that certain items were removed, some added, but primarily things were simplified. Many tasks that could be done in hardware were better accomplished by software, saving weight, space, time and above all it improved reliability. The main casualty to the spacecraft design from the users standpoint is the loss of the second cross-band transponder which had to be removed because of its weight and volume as well as the lack of development time. Also the hoped for S-Band (2300 MHz) beacon was the victim of WARC problems and timing (i.e. we couldn't be sure what frequency to use). Our redundancy on the satellite was reduced partially because of weight. But notice that we were able to learn from the problems of AMSAT-OSCAR's 6, 7 and 8 and apply this experience to Phase III. What limited the usefulness (and lifetime) of the Phase II satellites? You might agree that it was the batteries. We have never lost a transponder in our 12 spacecraft-years of experience with the Phase II satellites. Now, weightwise at least, a second transponder is a close trade for a battery. Yet, given the

Fig. 1 -- The final block diagram for the Phase IIIA Satellite. The design goals were followed closely. See text for details.



failure experience in space, one would have to logically argue for the inclusion of a redundant battery. Where redundancy was possible, it was applied in accordance with our failure experience. It was possible to simplify the hardware for the kick motor, the attitude control system and the communications system. The only disappointment to the designers was that while we had originally planned only for a 2k-BYTE memory in the IHU, and finally settled for 16k-BYTES, we very much wanted 32k. We almost attained it! More on this later.

Mechanical and Thermal Systems

Built entirely of sheet metal (by now, an AMSAT trademark) Phase IIIA underwent far more rigorous mechanical testing than any of its predecessors. The structure had three evolutionary phases. Compare the cover of June 1977 *QST* with the photo here. Various structures and components went through no less than five different vibration tests as well as a number of other compatibility related checks. All were successful. None of the mechanical load carrying members of the satellite, except the aft launch vehicle attach ring, were machined parts which greatly reduced costs. One particularly clever idea was the use of homemade fiberglass stringers which provided a much needed light weight solution to stiffening the spacecraft interior walls while at the same time acting as thermal isolators for the electronics modules. Details of this design were discussed in a previous AMSAT Newsletter.² If you investigate the geometry of the structure, you will find that for the given solar array area (side panels) the structure volume and weight are minimized while also providing superior moment of inertia properties (i.e. it spins well in space). Blockage of one solar panel by another is very minimal.

Thermally, the final design turned out not to be quite so straightforward. While it was originally hoped that at least the exterior design of each arm would be the same, it was not possible to accomplish this objective. It was necessary to thermally balance each electronic module separately. But the coating on the outside of arms vary. In particular, the arm containing the transmitter has an external surface that acts to maximize the emission of radiation while absorbing very little. Yet on the other two arms, the surface perpendicular to the sun has large areas covered by thermal blankets. The thermal mathematical model finally used for Phase III contained 121 different temperature "nodes" (data points throughout the structure) with 399 different conduction paths between them. Each computer run which simulated a particular orbit configuration required 3300 loop iterations and resulted in the computation of 400,000 node temperatures. The mathematical problem is equivalent to solving a set of 121 simultaneous linear equations each having between three and four terms for each position around the orbit and for each selected sun angle. The resultant design allows

Table 1—Phase IIIA Significant Technology Summary. A ★ indicates the first known use in an aerospace application.

Thermal System: Separate thermal design for each arm and the kick motor cylinder

- 121 Node Thermal Mathematic Model of Phase III used to assure proper performance
- Spacecraft capable of operating over sun angles of $0 \pm 60^\circ$
- ★ Spacecraft capable of operating through three hour eclipse period, all components within thermal specification
- Exterior thermal coatings selected to minimize contamination problems (particularly from kick motor chemical products resulting from burn)

Communications System: Transponder with command receiver and two beacons, antenna switching relays, antenna system

Transponder

- ★ High Efficiency Linear Power Amplifier (50W PEP) employing Envelope Elimination Restoration and Doherty amplifier technology 50% efficiency independent of drive level
- Peak and average agc loops optimized for SSB communications
- ★ 150 KHz Bandpass quartz filter used with shape factor of 1.16 (Insertion loss less than 0.5 dB)
- Engineering beacon employed PSK modulation- ± 90 phase shift used, optimum signaling technique because all transmitted energy contained in modulation sidebands, no carrier energy
- Use of Costas Loop demodulator for recovery of engineering beacon carrier on the ground
- ★ Simple audio frequency demodulator developed for low cost ground station use, compatible with SSB receivers
- Several command receiver technology advances

the satellite to operate safely with sun angles between ± 60 degrees, during a three-hour eclipse and even for a limited time with the sun directly on the top or the bottom of the satellite.

Power System

The Power System objectives of the Phase III design were particularly ambitious. At the beginning of life,

Structure: All sheet metal structure qualified to full Ariane loads

- Capable of withstanding 50g peak loads
- Allows installation of kick motor with virtually no alignment procedure
- Use of fiberglass stringers increases strength, reduces weight and allows thermal isolation of electronic modules
- ★ For given solar array area geometry of structure is minimum internal volume (weight) with virtually no array blockage

Power System: Solar arrays, batteries, BCR Telefunken Arrays

- Violet Cell Technology, 12.5% efficiency, 2cmx4cm size
- 0.5 mm cover slides used
- welded lead inconnects

Solarex Arrays

- Violet Cell Technology, 12.5% efficiency, 2cmx2cm size
- ★ Minimum specification/qualification approach used which reduced cost to approximately \$200/watt

Batteries

- Improved NiCad Technology to previous OSCAR satellites
- ★ Redundant "Cold Storage" spare concept used

BCR

- ★ Charge control via manipulation of array operating point, no shunt components used
- Array voltage and battery voltage adjustment under full IHU (computer) control allowing exact temperature correction
- ★ Current sensing accomplished by Hall-Effect torroid coils, no losses encountered in current telemetry measurements

Propulsion System: Motor ignition unit, arm relay, kick motor and other safety equipment

- ★ Unique decoding technique employed using PN sequence technology to assure personnel safety
- ★ Alternating current used to fire ignitors
- ★ Kick motor safety status monitored by IHU and ground computer (absolutely unique)

Attitude Control System: Sensor Electronics Unit (SEU), redundant Sun Sensors and Earth Sensor

- Simple but effective dual beam earth sensor using visible light diodes.
- Software algorithm with earth sensor finds true center of crescent earth
- Sun sensors resolve spin rate and solar aspect angle
- ★ Torquer coil used as sole means of attitude control in high earth orbit
- Mathematic model of earth's magnetic field and all orbit characteristics maintained in software on board spacecraft

Integrated Housekeeping Unit (IHU): Flight CPU, 16k Byte dynamic memory, command detector, 64 channel analog multiplexer

- 1802 Processor chip utilized special Sandia CMOS radiation hardening process (This part is very rare and expensive)
- ★ First known use of a single microprocessor used in a universal multitasking mode in a spacecraft, processor capable of working on eight simultaneous tasks
- ★ First known use of a high-level language on board a spacecraft, IPS a "threaded code" language was developed especially for Phase III
- ★ Hadimar error correction technology (12-bit code, 8 data bits) employed to guard against "soft" memory failures caused by alpha particle radiation, Mostek 16K (4116) memories used, soft error rate monitored by telemetry
- Selective radiation shielding employed on all IC's in the spacecraft, Tantalum chips bonded to top and bottom of each chip, local shielding saved considerable weight

Antenna System

- Circular polarization derived from 120 phasing of three elements
- ★ +10 dB of gain on two meters with constraints of Phase III structure (They said it couldn't be done, but that didn't stop us)
- Dual frequency 70cm/2M omni antenna

solar cells were to provide an average power of 40 watts or about six times that of AMSAT-OSCAR 7. After four years the satellite was still to produce 25w in order to maintain a 100% operating schedule. This requirement was particularly demanding because:

- A) Dedicated solar panels had to be developed for Phase III.
- B) The panels, given our size constraints, had to be of a superior technology to that of standard N on P

silicon solar cells (roughly 10%).

- C) The predicted degradation of cell performance caused by radiation damage required that the silica cover slides be thicker than the more conventional and less expensive cover slides used on most spacecraft.

It was decided that both the West German and American teams would tackle this problem in parallel. Clearly if both groups were successful there would be

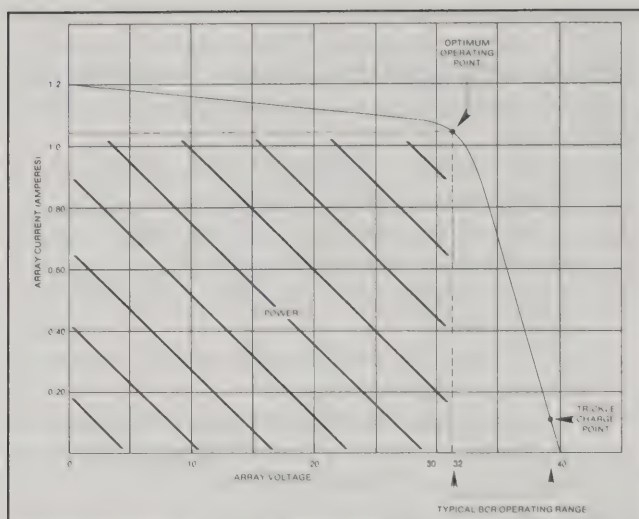


Fig. 2 -- The diagram shows the solar cell voltage-current characteristic curve.

no problem since enough panels for two missions were needed. As it turned out, both groups were successful and we ended up with 14 very fine solar panels (two sets plus two spares). AMSAT-DL was able to arrange a large financial contribution and obtained their panels from AEG-Telefunken in Wedel, West Germany. These panels used 2cmx4cm high-efficiency violet cells and 0.5mm/.020 in. fused silica cover slide. The cells were made during the production run for the Intelsat 5 program (welded interconnects between cells were also used). In the U.S., a different approach was used. In view of the very high cost of producing flight panels it was not possible to obtain panels made to standard aerospace specifications. By reviewing several typical NASA specifications it was possible to segregate testing and documentation that was mandatory from that which was desirable but not (in our judgement) essential. A new specification was prepared removing these non-essential items and it was circulated to a number of solar array vendors. Solarex, a firm in Rockville, Maryland, the world's largest producer of terrestrial cells as well as a line of space cells was awarded AMSAT's first major contract. Solarex representatives worked with us to establish a reasonable testing program as well as a set of requirements for quality assurance which made sure that the panels would function satisfactorily in space. AMSAT took on the task of running all qualification tests on a qualification panel. These tests were run at the Applied Physics Laboratory of John Hopkins University. Six more flight panels then were built to the same specifications and delivered by Solarex. By using this approach which minimized paperwork and some testing, it was possible to reduce the cost of the arrays from the current going rate of \$400/watt to less than \$200/watt. These panels used 2cmx2cm cells and also were of the high-efficiency violet cell type with 0.5mm cover slides. Both sets of panels produced the same output power when illuminated by the sun (27.5w each) although their physical and thermal characteristics were somewhat different.

The final efficiency of each of the panels was better than 12.5%. The objective of producing 40w of power was met with some margin. With good sun angles, the beginning of life power of Phase IIIA would have been in excess of 50w.

As has been previously mentioned, a decision had been made by all of the Phase III team to include two batteries in the spacecraft based on the results of the AMSAT-OSCAR's 6 and 7 and even early indications of some problems with batteries aboard AMSAT-OSCAR 8. After more than a year of paperwork AMSAT was able to obtain spare NiCad cells from NASA's ITOS weather satellite program as excess government property. This was a particular bonus for Phase III since these six amp-hour capacity NiCad cells were still within NASA date code (very current manufacturer date) and were two generations in technology ahead of those flown on AMSAT-OSCAR 7. Ten of these cells were used as the primary battery on Phase IIIA. The auxiliary or backup battery was composed of ten four-amp-hour cells produced by SAFT Corp. of France. They were a contribution by the European Space Agency (ESA). The power system was designed in such a way that while the primary battery was switched on line, the aux. battery was stored discharged. Only after degradation of the primary battery would the aux. battery be trickle charged and then switched to the main bus removing the old main battery. By this date in the lifetime of the spacecraft (hopefully about four years after launch) the solar array power would have dropped significantly and during eclipse operations the reduced power mode (Mode C if you wish) would be used. Under these conditions a four-amp-hour capacity aux. battery would be adequate. By using these smaller cells for the aux. battery additional weight could be saved.

In order to prevent the battery from overcharging at all times, a current regulating device must be inserted between the solar arrays and the battery. The battery charge regulator (BCR) in most spacecraft is a shunt regulator which implies that excess power not needed by the battery or the loads is shunted to ground via large load resistors. This means lots of big power components and shunt paths to ground, all of which can result in failures. In some cases these could be catastrophic. It would seem logical then that if the power is not needed, why produce it in the first place? In other words, solve the problem at the source-the solar arrays. Since the design of AMSAT-OSCAR 7 we have been using a unique solution to the BCR problem that, to my knowledge, has never been widely circulated. The I-V curve of a solar cell (or several in series/parallel) has an interesting property (see Fig. 2). It acts as a constant-current generator over a wide voltage range, however, as the voltage is increased (load decreased) beyond a point known as the knee, the array current will decrease. By taking full advantage of this property the operating point of the array can be selected to coincide with the battery charge state. The technique used by all of the OSCAR spacecraft since 1974 has

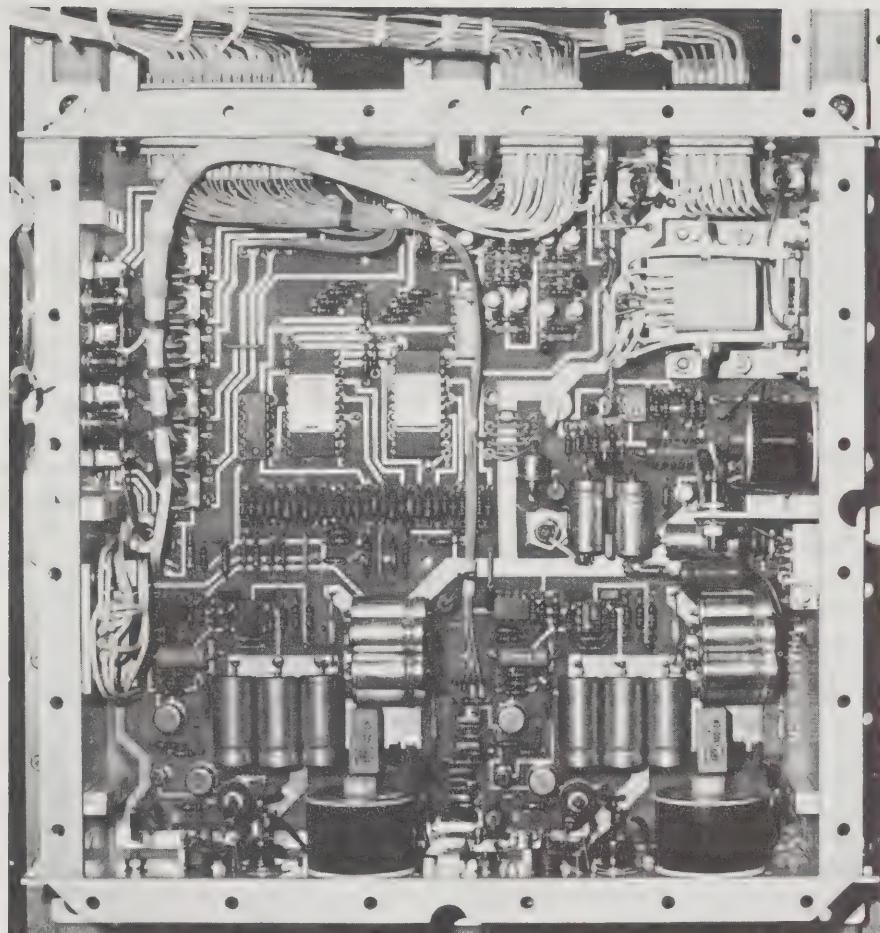


Fig. 3 -- Battery Charge Regulator.

been to determine the state of charge of the battery by sensing the battery voltage and then adjusting the input voltage from the arrays by a voltage-adjustable Zener diode. The counter intuitive feature of the BCR is then that the array current is decreased by sensing an increase in battery voltage and then increasing the array voltage. There are two problems with this approach. Both the battery cell voltage and the array operating point are temperature dependant. With the BCR's on the AMSAT-OSCAR 7 and 8 spacecraft the temperature compensation was done to a first order at the input and output by making the assumption that the temperature coefficient of the arrays and battery could be equated to that of a temperature sensitive transistor junction. Also, that the particular transistor used (which was inside the BCR) was isothermal with the array and the battery cells. While the first assumption proved to be valid, flight data shows that the latter judgement was not. In addition, there are important second-order effects on these operating points caused by the slow effects of radiation damage to the solar cells along with chemical changes within the NiCad cells. All of this makes a BCR where these coefficients are set-and-forget far from ideal (yet still workable as you can see from AMSAT-OSCAR's 7 and 8). Now, Phase III solves all of this by the relatively simple process of placing the input and output BCR voltages under computer control. The computer then may act as the controller and the software can make use of all relevant information available such as actual array and battery

temperatures as well as data related to long and short term time dependent phenomena. As more is learned about the satellite from the ground, new coefficients or even new control programs can be uplinked into the spacecraft computer.

Designed and constructed by the Amateur Radio Club at the Technical University of Budapest, Hungary (HG5BME) the Phase IIIA BCR module was fully redundant and served a number of functions beyond that of a battery charge regulator, including:

- 1) Fully redundant +10V regulators for all spacecraft logic power.
- 2) Switch over relays for BCR selection (1 or 2), battery selection (main vs aux.), and aux. battery charging. These are controlled by the spacecraft computer (IHU).
- 3) All Solar array protection diodes.
- 4) Digital-to-analog converters for control of the BCR input and output voltages by the spacecraft computer.
- 5) A wide variety of telemetry outputs which measured all relevant voltages and currents. Currents were measured using a special Hall-effect torroid device which resulted in no power loss as a consequence of the measurement.

The BCR also acted as a voltage down-converter taking power from the solar panels at 28v and supplying power to the battery and loads at 14v with an overall efficiency of 87%.

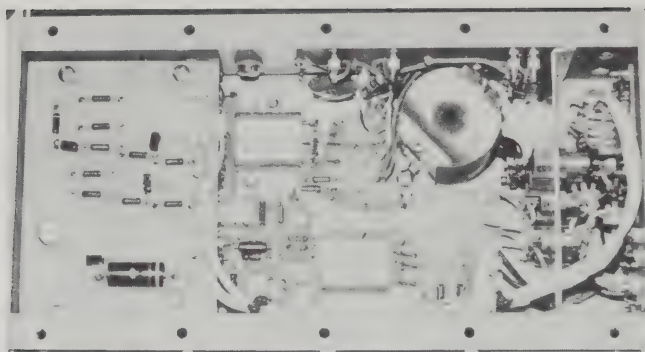


Fig. 4 -- Circuit board for the Motor Ignition Unit.

Propulsion System

The propulsion system on-board Phase IIIA was designed to modify the initial Ariane orbit. It increased the inclination and the perigee in order to provide a stable orbit that would give superior communications capability. The details of the initial and final orbits have been reported previously.^{3,4,5} By the time the spacecraft was completed it was ready to go on a "diet" as it was 10 kg. heavier than the design or "target" mass. While this caused some considerable consternation at first, it was determined that by modifying the orbit transfer maneuver and using all of the excess performance of the kick motor it was still possible to get within 1 degree of the desired inclination. With our final spacecraft weight of 85.7 kg., the kick motor would have changed the speed of the satellite by 1124 m/sec. More than any other feature of the spacecraft, the designers wanted to prove that amateurs were in control of the technology to successfully make a major orbit transition. This in itself would have made the time spent worthwhile.

The technology necessary to simply fire a kick motor is trivial. The technology needed to convince the professional world that "hams" can fire a kick motor safely is not necessarily trivial. This task on Phase IIIA was to be accomplished by the motor ignition unit (MIU). Simply put, when power was applied to the MIU it would monitor the engineering beacon line. The MIU was hard-wired to recognize two PN (pseudo random) bit sequences (one very long and one shorter). Both sequences were sufficiently long and "random" that their probability of occurring in the normal telemetry sequence was effectively "0" (unless you are a mathematician in which case I will use the Phrase "vanishingly small"). Upon recognition of one of the sequences the appropriate ARM or FIRE relay would be closed for a short period of time. If both PN sequences are sent within a specified time window causing both relays to close, then the motor would be ignited. The ARM relay was physically located very close to the kick motor ignitors and acted as a final safety intercept. A SAFE/ARM plug was also in line with the firing signal to provide an additional intercept. Beyond all of this all power was locked away from the entire system by the spacecraft separation switches.

Now, it should be noted that under normal sequences the two PN sequences needed didn't exist anywhere on-board the satellite either in hardware or software. It was therefore, impossible to fire the motor by accident or otherwise with things in this condition. Just before the motor was to be fired a command station was to place the "keys" (PN sequences) into memory at the appropriate locations. At this point the spacecraft IHU was to take over. At the specified time the computer would have checked all of the relevant telemetry points. If all data was within tolerance, the spacecraft attitude would have been verified to assure that the kick motor was vectored in exactly the right direction. At this point the keys would have been transmitted on the engineering beacon, received by the MIU and within milliseconds Phase IIIA would have been on its way to the new orbit. Twenty-two seconds later the motor would have completed its task.

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(Part II will appear in a subsequent issue of *ORBIT Magazine*)

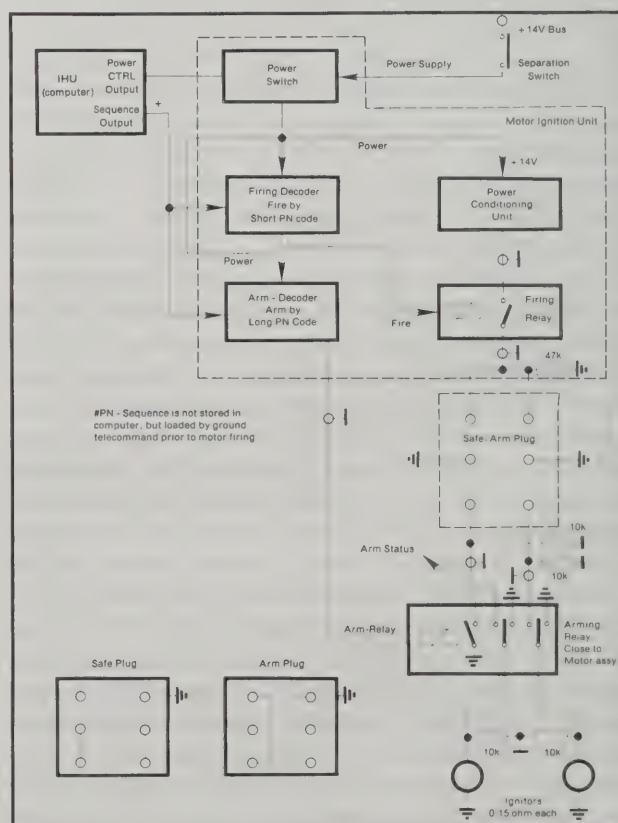


Fig. 5 -- Kick motor safety arrangement.

Good News

The World-Wide Communications System Works Perfectly.

. But the Phase IIIA Launch Fails!

Bad News

"Splashdown!"

With that single word heard 'round the world', a chill of profound disappointment raced up a thousand spines and an empty, glazed countenance appeared on thousands of other faces. It all came together last May 23; And then it all came undone. The years of planning; the sweat; the frustration; the sacrifice. Yet despite the crushing sense of defeat felt at that moment by the thousands listening, their very awareness of the circumstances of Phase IIIA virtually in real-time was a victory of sorts for AMSAT---albeit a cup of rather bitter wine.

The bad news was very bad indeed. The Phase IIIA spacecraft, and the hopes of Amateur Radio for an early start to the new era in satellite operations with unprecedented communications, lay in pieces on the floor of the Atlantic. The good news was that the mechanism by which many learned the demise of the object of their affection worked extremely well. In the paragraphs that follow, I will briefly explain how this mechanism, called ALINS, came to be, what it was supposed to do, who did it and how it turned out.

ALINS is the AMSAT Launch Information Network/Service. ALINS as a concept evolved from two main sources. The first was AMSAT's previous experience with the launch of the OSCAR series satellites and the transmission of the launch countdown on the air by Amateurs. The second was an idea put forth at an AMSAT Board meeting in October of 1979. At that time WA2LQQ was directed to organize a communications program for maximum coverage of the launch countdown. The coverage area would have to be commensurate with the apparent interest level in the fate of Phase IIIA, i.e., world-wide. The point of departure was that the network should have two transmitters: One on the East Coast to cover Europe and Africa and a second on the West Coast to cover the Pacific. It was assumed that U.S. stations would be able to obtain information by another (unspecified) mechanism. Present at the Board meeting was John, W6XN, who suggested that the West Coast station responsibility might be filled by the Lockheed Missile and Space Amateur Radio Club, WA6GFY. John would approach the Club and advise regarding their intent. Will, WB2TNC/3, also at the Board meeting, suggested that a likely candidate group for the East Coast function was the North

By Vern Ripportella,* WA2LQQ

Jersey DX Association among whose members are numbered satellite DXCC holders Ben, W2BXA, and Bob, W2LV.

As it turned out, the suggestion of WB2TNC/3 was particularly valuable inasmuch as to maximize coverage to Europe required an early evening local time in the target area which of course warranted an afternoon transmission time from New Jersey. Since W2BXA and W2LV are retired, they could assume the assignment with minimum disruption. Filling out the NJDXA Team was a third retiree, Joe, W2YY. These three first rate ops would transmit to Europe and Africa.

Within a week W6XN reported back that the Lockheed station, WA6GFY, would be available for ALINS and that Hugh, W6TWU, and Claude, N6OO would staff the Lockheed team together with W6XN.

With these resources committed to ALINS we began the serious planning. The basic concept for Launch day coverage was to take a live audio "feed" from an observer close to the launch and with suitable buffering introduce that audio into the Amateur Bands. The audio feed was identified as an audio interchange between ESA in Kourou and NASA at the Goddard Space Flight Center, Greenbelt, MD. This circuit worked extremely well for the Ariane L01 Launch on Dec. 24, 1979 when the audio arriving from Kourou at Goddard was patched to WA2LQQ in New York from where it was transmitted on 28.880 to Europe. The circuit to which hundreds of Europeans listened last Christmas Eve was simple but effective and whet the excitement appetite of those listening for the things to come the following May.

Meanwhile several other tasks surfaced. W3GEY, Phase III Project Manager indicated it would be helpful to be able to communicate with the remote ground command stations via ALINS. In addition, there appeared a growing need to obtain Doppler measurements of the Phase IIIA spacecraft shortly after launch to supplement the auto-ranging capabilities of the command stations. The Doppler measurements would be best made by stations lying very near to the Equator since the perigee of Phase IIIA in the transfer orbit was a latitude of about 3 degrees South. Thus another functional requirement was identified for which ALINS seemed the likely vehicle.

*Author's address given on page 40.

At this stage ALINS was not required to be bi-directional. That is, in the original concept, information sourced at Goddard (Kourou) would flow outward. Now we would also prepare the path for information flowing inward to the analysts at Goddard and Marburg (Germany). Furthermore, the active period for ALINS became more protracted. Instead of Launch-Day coverage only, what evolved was a 3-Phase project, namely;

Phase 1: Pre-Launch Activities

Phase 2: Trans-Launch Activities

Phase 3: Post-Launch Activities

The Phase 1, Pre-Launch Bulletins would run for the 7 days immediately preceding launch to inform all those concerned of the present status of the launch schedule, i.e., were schedules holding? This was vital to those who had to arrange for their personal affairs to mesh with the launch.

Phase 2 would run from 12 hours before to 12 hours after launch (the trans-launch period) and be the period of maximum effort reflecting the period of maximum interest/audience.

The third phase would be to provide in the post-launch era (for approximately 30 days until the spacecraft was fully operational and available for general use) information regarding time/position of Phase IIIA, orbital elements, status reports, tracking guides, etc.

At about this time it became apparent that U.S. coverage needed to be improved, for many interested individuals would be at work at the time the NJDXA bulletins (under the callsign W2JT) and the Lockheed Bulletins (under the callsign WA6GFY) would be transmitted.

By early February, 1980, the outline of a plan had been drawn up but many important pieces of the organizational puzzle were missing. Fortunately it was also at this time that a formal commitment from A.R.R.L. was made to AMSAT to dedicate the entire W1AW RF facility to ALINS for Launch Day use. This was a most desirable development for it allowed much better use of the other, previously identified resources, not to mention the excellent technical capability at W1AW.

With these resources identified and awaiting direction, the detailed planning began with the assignments of frequencies, identifying coverage zones, determining transmission times, etc. W2RS lent his expertise to the Project by helping to identify optimum frequencies for the targetted areas that might be expected to produce the best coverage on Launch Day.

By early March the Plan was ready. W2JT (W2BXA, W2LV, W2YY) and WA6GFY (W6XN, N6OO, WA6TWU) would transmit the Pre-Launch and Post-Launch Bulletins with W2JT covering Europe and Africa with 6 bulletins per day (2 each on 20, 15 and 10 meters), and WA6GFY covering Asia and South Pacific on 20, 15 and 10 with 6 bulletins per day (2 each band).

For Launch Day, W1AW would transmit on all bands from 80 through 2, WA6GFY would transmit on 20 and 40 and WA2LQQ would be on 20, W2JT was held in ready reserve should a failure at one of the other stations occur or if severe lightning prevented transmission of the Launch by one of the other stations.

By the first week in May all was in readiness. W1AW had installed an elaborate audio patch system, WA6GFY had patching capabilities expanded, bulletin formats had been specified, administrative mechanisms had been formulated, the ALINS launch day network configuration had been exercised and the final plan had been published and distributed.

Then, finally, came the day to implement these months of planning. On Friday afternoon, May 16, 1980, one week prior to the scheduled launch, W2BXA, transmitting under the callsign of the NJDXA, W2JT, began the ALINS with his 10 meter transmission to Europe. Ben's initial bulletins were heard well on all six transmissions on the three assigned bands as reported by G3IOR. Later that afternoon WA6GFY began its regime of 6 bulletins beamed at Japan and the South Pacific. Later still that evening (0200UTC, Saturday, May 17) WA2LQQ initialized the 75-meter Bulletin and ALINS on 3850 kHz.

It is a compliment to those who participated that things went so well for the next six days. The vital information was released and literally tens of thousands of Amateurs around the globe received up-to-the-minute reports via ALINS. The stage was thus set for the 23rd of May.

ALINS began that fateful day with a callup from the Goddard SFC at 1100 UTC by W3IWI. In addition to W1AW, WA6GFY and WA2LQQ on the network, W3XO was added to provide coverage in the Washington, D.C. and Baltimore areas via 2 meter repeaters.

Since the line from Kourou to Goddard was sub-optimum, W3IWI functioned as an information regenerator in addition to the previously defined buffering task. In this role Tom integrated ESA-sourced information and AMSAT-sourced information and introduced it into the ALINS. As it turned out AMSAT's sources proved more efficient than the ESA-NASA interchange in getting the information out to the field. This route comprised DK4VW and the entire FY7 crew at Kourou, linked to WA3NAN at Goddard on 15 meters where K1HTV and K9LF who relayed to W3GEY and W3IWI in the GSFC control room via 2 meter simplex.

As most everyone is aware, L02 finally got off the ground at 14:29:42 for a very, very short ride.

The drama of the event was emphasized by the unprecedented world-wide audience. Estimates are that several tens of thousands listened keenly to the countdown as relayed by W3IWI on ALINS. Additional thousands followed the developments on near-real-time buffer stations such as individuals who reported the ALINS transmissions immediately on their local 2-meter repeaters or regenerated the data in another mode such as AB4Y's interface to the RTTY Net. Still others such as Miki, JR1SWB in Tokyo, provided translation/buffering for local consumption by non-English-speaking Amateurs.

It is ironic that a vehicle (ALINS) should be so manifestly successful yet bear such a sorry "passenger" (the bad news).

Well, in any case what had been planned to be a summary of the successful launch on that evening's 75

meter session turned into something quite unexpected. The evening of what has since come to be called 'Black Friday' saw something quite remarkable and unparalleled in my experience in Amateur Radio.

What began as an ad hoc wake and forum for commiseration on the deep sense of loss shared by the hundred or so stations gathered instead evolved very quickly to a forum for expression of support.

There was a heart-felt expression of support from AMSAT members and non-members alike for the goals of AMSAT. Indeed the session became a mandate for rededication and recommitment in the very face of adversity.

Had we envisioned ALINS as a vehicle for this overwhelming expression of unified determination to "press on?" Of course not!

As Project Manager for ALINS I reflect now on the range of emotions I felt then. (Remember the one about mixed emotions---that's where you watch your mother-in-law drive off a cliff---in your new Porsche).

That's about the way I felt knowing that the information vehicle (ALINS) was running smoothly but that the information content was bad news....very bad news indeed!

But with the loss-trauma put aside now, we can look back at the things that worked well. First, naturally it is important to note that the Phase IIIA bird was work-

Ed. Note: A diagram for ALINS appeared on page 6 of the last issue.

ing well up to the moment Ariane L02 self-destructed. For this accomplishment, AMSAT may ever hold its head proudly. Second, the support activities for the Phase IIIA Launch also worked well indeed.

The ALINS provided an intangible, though. It allowed many far-afield a share in the unparalleled excitement of watching a dream about to come to fruition--indeed ALINS was the vehicle for this shared excitement at the critical moment--and later the vehicle for commiseration and shared grief. Yes, ALINS did work well, in fact. Thanks are due to those who made it work through their diligence and expertise. Their callsigns are listed below.

Looking ahead, we will certainly have a well-polished vehicle (ALINS) for future launches. Furthermore, while the vehicle may be well-polished, we trust that the passenger (info-content) will be substantially more agreeable in the future.

Acknowledgement and thanks for ALINS go to:

At W1AW: K1JX, W1EH, W1WPR, WB1EYI, W9KDR

At W2JT: W2BXA, W2LV, W2YY

At WA6GFY: N6OO, W6TWU, W6XN

At WA3NAN: K1HTV, K9LF

At GSFC: G3ZCZ/W3, W3GEY, W3IWI, W4PUJ

Also AMRAD, the team 2 at FY7AS, Maryland FM Association, W2RS, W3XO

The Doppler collection team: DU6EG, HC1AR, HC1BI, HC2HX, HP1AC, TG9SO, TI2NA, TR8BL, ZK1AA, ZP9AY, 9M2CR, 9J2KL
WA0OHO for Plans Dissemination

Around the World



Articles about the Radio Amateur Satellite Program are being published around the world. Some of this material, which appeared in language other than English, was never translated and thus did not reach the maximum number of interested readers. This new feature in *ORBIT* will provide an abstract of such articles as they appear, and provide an indication of the level of publishing activity worldwide in the field of Amateur Space activities.

Ham Journal, Summer 1980 (Japan)

This issue is almost entirely devoted to the Phase IIIA satellite, originally designed as an operators or users manual for the Japanese Radio Amateur. It contains articles by JR1SWB, and a small contribution by G3ZCZ (JA1) as well as photographs by JA1ANG and G3ZCZ. The drawings and photographs are easily understandable by non-Japanese speaking radio amateurs and make this issue of *Ham Journal Magazine* a souvenir to be treasured.

Radio Communication, May 1980 (England)

G2BVN writes an interesting and high quality article about the Phase IIIA satellite. The magazine cover is also devoted to the Phase III.

Radio REVISTA, May 1980 (Italy)

This issue carries I8CVS's regular column on Space (OSCAR-APT-EME) Activities and AMSAT-Italia. The column is devoted to the Phase IIIA satellite. The magazine cover is a color picture of the Phase IIIA satellite mounted on the Ariane launch vehicle.

CQ DL, May 1980 (Germany)

Alex Schoening, DC7AS, contributes a photo essay on the Phase IIIA spacecraft, and gives details of the ALINS launch day German-language relay by DL3SX via VHF/UHF FM repeaters.

CQ DL, June 1980 (Germany)

Alex Schoening, DC7AS, describes the German contribution to the Phase III program, also carried in this issue of *ORBIT*.

QTC, May 1980 (Sweden)

The regular column by SM5CJF contains details of the ALINS launch day schedule.

Electron, July 1980 (Holland)

PA0JOU briefly describes the launch failure of the Ariane L02 vehicle, and indicates that the Phase III program is not dead. Phase IIIB is still to come.

Radio ZS, May 1980 (South Africa)

ZS1BI contributes a small piece about Southern Africa AMSAT and briefly mentions on-going satellite programs (eg. SYNCART from Canada, RS from the Soviet Union and Arsene from France).

Radio, January 1980 (USSR)

This issue contains a brief illustrated article about the Soviet exhibit at TELECOM 79 and further experimentation in RS flight hardware at the DOSAAF Volunteer Space Technology laboratory. The photos show the people involved as well as flight and ground test hardware.

Radio, February 1980 (USSR)

This issue contains an article describing a circularly polarized 144-MHz antenna with 11 dB forward gain designed for the amateur satellite service. The antenna is based on two Yagis mounted on the same boom at right angles to each other.

On May 23 the international AMSAT team was ready with the product of many years of blood, sweat and tears. The radio amateur community waited with eager anticipation through the long countdown. At 14:29:21 our progeny sent back a frame of telemetry that said "I'm ready -- let's get this show on the road!" (See Fig. 1) A few seconds later the rocket ignited. Within minutes, our child, with its promises unfulfilled, lay dead on the floor of the Atlantic ocean. This is now all history -- do we, the radio amateurs of the world, let this still birth be in vain?

To be able to answer this question, we must review just what we lost. We must take out our accountant's pencils and ledger sheets. We must put aside our emotions, for the real world of spacecraft building involves real, material resources. I find it most convenient to tackle this accounting exercise in the form of a series of questions and answers.

testing were done in AMSAT's Washington laboratory and final testing and "fine tuning" were performed in Marburg, Germany. AMSAT-DL was responsible for all ESA interfaces. A joint AMSAT/AMSAT-DL team handled launch vehicle interfacing and testing in Toulouse and Kourou. The definition of telecommand protocol and all flight software was the responsibility of DJ4ZC as the system architect. AMSAT provided the range safety computer and software for Kourou. AMSAT-DL provided the prime command station in Marburg, while AMSAT coordinated the rest of the world-wide tracking and command network with stations in the US, Canada, New Zealand and England.

That's Quite a List. How Much Labor was Involved?

About 30 person-years (p.y.) total. Of that total, the continental European effort (DL plus HA) accounted for about half, and the rest of the world the remainder.

SPACECRAFT ECONOMICS...

Who Built Phase IIIA? The word "built" has many facets. In general, the spacecraft was a joint project between AMSAT and AMSAT-DL. The basic design and architecture was the product of the technical arm of AMSAT-DL under the direction of Dr. Karl Meinzer, DJ4ZC, most of his group is affiliated with the University of Marburg. AMSAT-DL provided many of the spacecraft modules and sub-systems including the transponder, the attitude determination and control system including two of the sensors and their associated electronics and the computer-controlled electromagnet, the computer's memory, and many of the mechanical fixtures. AMSAT provided the flight computer with its analog multiplexer and command detector, antennas, one of the sun sensors, wiring harnesses and cables, a set of batteries and most of the "sheet metal" and mechanical fixtures. The second set of batteries came from France. One of the two sets of solar panels came from AEG Telefunken through AMSAT-DL, and the second from SOLAREX through AMSAT (the flight configuration was three panels from each source). AMSAT arranged for the kick motor through THIOKOL. A group at the Technical University of Budapest under the direction of Dr. Bandi Gschwindt, HA5WH, provided the battery charge regulator module. AMSAT's Japanese affiliate, JAMSAT, provided the band-pass filter for the transponder. AMSAT's Canadian members provided a number of mechanical fixtures. Spacecraft integration and initial

This estimate does not take into account the countless hours spent in planning for Phase III operations, or keeping the "business side" of the organizations functioning, or fund raising, or the time invested by the users in building their own stations, etc. If these had been included the totals would have been much greater. Of the AMSAT crew, about a dozen people were in the 800+ person-hour (p.h.) category (remember that 2000 p.h. = 40 hours a week for 50 weeks = 1 p.y.). Another dozen or so individuals made up the rest of the group we call the "hardcore" that delivered AMSAT's part of Phase IIIA. While I don't have the breakdown for AMSAT-DL or the Budapest group, I'm sure that their distribution is very similar.

How Much Money was Involved? We have reviewed AMSAT's ledger and find the following figures for the Phase IIIA expenditures:

1977	\$11,000
1978	43,740
1979	91,810
1980	62,840

Or, in round
numbers \$210,000

I do not have access to the AMSAT-DL totals. The Marburg group, operating within the University environment, have different financial accounting procedures. I do know that the Deutscher Amateur-Radio-Club e.V (DARC), IARU Region I and other European societies have donated substantial amounts to AMSAT-DL.

In addition, the two dozen AMSAT "hardcore" workers incurred personal, non-reimbursed expenses of about \$30,000 for travel, telephone, and out-of-pocket costs for Phase III unique command station hardware, supplies, etc. Although this does not appear in AMSAT's books, it certainly represents a part of the real costs of Phase IIIA.

Also not appearing on the ledgers, but representing real costs, are the commercial donations. The list is far to lengthy for this report, but we estimate the total to be in excess of \$200,000.

totalled \$7400. Ground-support computers, computer components and RF hardware for the command stations, computer supplies, test equipment and similar hardware for use on the ground totalled \$9700. Special "high-rel" parts, printed-circuit boards, thermal control materials, potting and bonding chemicals, wire and cable, nuts and bolts, etc. amounted to about \$30,000, for a total hardware cost of about \$75,000.

The third major category of expenditures, accounting for about \$30,000, was the transportation of people, hardware and ideas. With an international program, involving activities on five continents, travel and communications for coordination became a major effort. Jan and Karl each made numerous trips across the Atlantic, and our Telex machine was chattering daily. The integration and testing campaigns in Washington, Marburg, Toulouse and Kourou involved several people being away from home for intervals of several

"The once and future satellite"

By Tom Clark,* W3IWI

One more cost that should be included to access the "worth" of Phase IIIA is the equivalent value of volunteer labor. About 4 of the 30 p.y. mentioned earlier came from salaried AMSAT employees who were already included in the \$210,000. The remaining 26 p.y. was certainly "worth" the median US engineer's salary of about \$23,000. per year, so the labor was equivalent to about \$600,000.

Adding up all these figures we come to the conclusion that Phase IIIA was a \$1,000,000+ satellite. This is the "worth" of what we lost on May 23.

Where Did The \$210,000 Get Spent? Why Did It Cost So Much? Again the ledgers provide the answers. The single most expensive item was salaries. Our favorite "pin-up girl", Marie Marr and Clark Greene (K1JX) were on the AMSAT payroll for a total of about 3½ years. Perry Klein (W3PK) and Jan King (W3GEY) each accounted for about ½ year; however most of Perry's and Jan's efforts on Phase IIIA appear on the volunteer side of the ledgers. The total of these expenses was about \$100,000.

The next most expensive set of expenditures was for real hardware. We note that the solar panels, including the honeycomb substrates totalled \$28,100. The "sheet-metal" for the spacecraft, the shipping container, separation springs and other mechanical items

weeks. Coordination meetings and telephone calls to get the command station network ready were a non-trivial expense. In my total for this category, I didn't even include any of the AMSAT-DL expenses, which were certainly comparable to AMSAT's.

The remaining \$5000 in the total of \$210,000 covered the myriad small expenses of outfitting the AMSAT-OSCAR Spacecraft Laboratory with workbenches, desks, tools, and even paint for the walls. Other miscellaneous expenses included in this figure were drafting supplies, office supplies, photographs, printing and other "business" expenses.

Where Did \$210,000 Come From? When a Life Member pays his \$100 (\$200 since July 1, 1980), or when a club joins as a Life Member Society, half the contribution goes into a Reserve fund. The interest derived from these reserves "pays" for the member's *ORBIT* magazine and defrays some of the business office costs. These reserves also are used as security for long-term commitments and serve as a "cash-flow" buffer. The other half of the Life Member's donation is immediately earmarked for spacecraft construction activities. There were about 1500 Life Members on launch day, so their contribution was about \$75,000 (or 36% of the total). About two-thirds of the Life Members reside in the USA, and the remaining third are well distributed around the world.

*President, AMSAT

Members, users and supporters made contributions through our "sponsor a solar cell" program ranging from \$10 for a solar cell or \$100 for a battery cell, all the way up to \$1000 or more to sponsor larger modules. After modest administration costs were deducted, this campaign raised about \$50,000 (24%). About 93% of these donations came from the USA, Canada and Japan.

Another \$30,000 (14%) came from a couple of large individual US donors who prefer to remain anonymous. Other donors made contributions earmarked for the amateur satellite activities through the ARRL Foundation (ARRLF). When combined with original Eitel-Hoover matching Fund monies remaining in the ARRLF, and the interest derived from these funds, the ARRLF contribution totalled about \$40,000 (19%).

The remaining 7% or \$16,000, came from a donation by the ARRL. When AMSAT agreed to work with the ARRL to provide OSCAR 8 as a "gap-filler" following the demise of the AMSAT-OSCAR 6 spacecraft, the ARRL made a donation of \$50,000 to defray our costs and provide a stimulus for the Phase III program. AMSAT's actual out-of-pocket costs for OSCAR 8 were \$34,000.

Substantial funds donated by International Amateur Radio Union (IARU) Region I (Europe and Africa), and various European amateur radio societies were transferred directly to the AMSAT-DL organization and were not included in this summary of AMSAT's finances.

I'm Not a Life Member. I Don't See My Dues in the List Of Contributions. Why Not? When you consider the publications costs for the AMSAT Newsletter, or its replacement *ORBIT*, *PLUS* the salary of our Office Manager, Martha Saragovitz, *PLUS* the rental on the office, *PLUS* telephone, postage and other "business" expenses, your dues just "pay" for the services you receive. In fact, the recent dues increase was necessary just to pay the bills! If we get more advertising support for *ORBIT*, or if we can increase the sales of *ORBIT* at the book-stands in local radio stores, or if we can amortize the office expenses over more members, then some of your dues will go to support the spacecraft directly. I note that the "pie-charts" in the July, 1980 *QST* (page 50) show a similar picture for the ARRL; the member's dues do not cover all the services that the member receives.

What is AMSAT's Current Financial Situation? We had planned all of our activities based on a successful Phase IIIA launch and these plans were thrown into a state of turmoil on May 23rd. We had made commitments to publish *ORBIT* as a professional journal of amateur satellite activities. We had spent virtually all our resources (except for the Life Member reserves) on the "bird". The outpouring of sympathy following the launch failure was accompanied by a number of free-will donations. About 250 new Life Members signed up in time to beat the July 1 dues increase. We tightened

our belts and cut our costs to a minimum (this is the reason that *ORBIT* hasn't as many pages as we would have liked). With the concurrence of AMSAT's Board, I committed a major portion of the Life Member reserves to secure Jan King's salary for two years in order to keep him on AMSAT's "first-string" team. All this leaves us in the black through 1980 -- but just barely!

This situation was not what we had planned for. Had Phase IIIA been successful, our anticipation was that the interest in the new satellite would create a sizeable new membership base. We had to gamble all our resources on success -- and we lost.

So Things are Tight. We Lost Phase IIIA. What Will It Take To Build a Replacement? The answer to this question depends on the details of potential subsequent launches: When? Who? Where? Jan and Karl are hard at work trying to secure a launch for a replacement Phase IIIB, but the verdict is not yet in. For planning purposes to generate an estimate of our requirements, we have made the following assumptions, which may or may not prove to be correct:

- (a) Phase IIIB will be launched in the first half of 1982 on a non-US (e.g. ARIANE) launch vehicle.
- (b) AMSAT will also be providing some support to the University of Surrey for UOSAT, with a launch scheduled in Sept. 1981.
- (c) The inflation rate is zero (!) and hence all monies are reckoned in terms of 1980 US dollars.
- (d) Principal groups and their roles will be the same as for Phase IIIA. AMSAT-DL will arrange for their own funding which will support their activities.
- (e) Phase IIIB will make maximum use of Phase IIIA technology and existing resources (e.g. the spare solar panels) will be used.
- (f) Phase IIIB testing program will be more extensive than Phase IIIA.

That's Nearly \$270,000. Why is it More Than Phase IIIA? First, inflation is taking its toll; the costs for travel have nearly doubled in the past year. Second, salaries will account for a third more than they did for Phase IIIA; I'll address this point later. Third, although the "hard-core" put out \$30,000 for Phase IIIA, it would be unfair to ask them to do it again. Fourth, I've included a new category, "Interns", which did not appear in the Phase IIIA budget, again a point which I'll address later.

These factors all serve to increase the budget; they are offset by those elements which were not lost on May 23rd: We have a full set of solar panels on hand. The telecommand station network is intact and ready to go. If the launch configuration doesn't change too much, we have the spare sheet-metal spaceframe and its shipping container, and the wiring harness is nearly complete. And most important, the team, and all the knowledge, skills and technology that they developed, is still intact.

Why Do We Need Salaried Staff to Build the Satellites? Can't Volunteers Do the Work? Unfortunately, no. The need to interface our **amateur** activities with the **professional** aerospace community causes some unique problems. We must meet the professionals on their terms. This means that contacts must be made in the 9-to-5 weekday time window. We must show them that we are a responsible organization and this means that **they** must know how to contact **us**. We have to provide incredible volumes of documentation on the schedules that they lay down. Our principal contact must either have a benevolent employer who is willing to overlook (or perhaps even bless) the amateur activities, or AMSAT has to act as the employer. Up through OSCAR 8 and even in parts of the Phase III program, the volunteer mode was possible, but at the expense of the professional career development of some of the key individuals. These days now seem behind us. If the amateur satellites are to evolve from the "gee whiz" basement spectaculars into a long-term sustained service-oriented activity, then the handwriting is on the wall -- the **amateur** satellite activities must themselves become **professional**. A nuclear staff of paid engineers, who have the responsibility to manage an ongoing program and who interface the amateurs with the professionals, seems to be the only way.

The volunteer/amateur workers certainly have a place in the future activities. Their expertise, talents and energies will continue to produce the concepts and hardware. These "amateur" amateurs will draw on the services of the "professional" amateurs for those coordination tasks that they cannot do because of their need to earn a living during the daylight hours.

The Budget Shows a Line Labelled "interns". What is This? The Intern Program is a new idea to provide a mechanism to educate the next generation of satellite builders and to transfer technology between the various AMSAT affiliates. The general idea is similar to hospital Intern training in the medical profession. A new doctor, fresh from school, decides to specialize in some field. He makes application to a teaching hospital which emphasizes his field of interest -- perhaps neurosurgery. The intern learns by observing, lectures and eventually on-the-job training under the close supervision of the master. The intern also broadens his horizons by exposure to all the related fields. Although outside his specialty, the experiences learned in the Emergency Room taking care of the victims of a traffic accident will remain with him throughout his career. Coffee-room discussions on personal business management set in motion the ideas that, in future years, will allow him to accrue personal wealth. And the camaraderie engendered by personal contacts, both with masters and peers, will last him throughout his career.

Let us carry this analogy over to amateur satellite activities. The novice neurosurgeon becomes a young, eager engineer who wants to expand his horizons. He proposes to come work with the "masters" and in the course of doing so, both AMSAT and the individual prosper. Some fraction of the interns could be the future W3GEY's and DJ4ZC's; we **must** look towards the future by training our successors.

In a sense, we have already had some interns: Ron Dunbar (W0PN), spent several weeks during 1978 with DJ4ZC in Marburg, learning and understanding the IPS computer language and brought back the nucleus of

Category	July-Dec. 1980	Jan.-June 1981	July-Dec. 1981	Jan.-June 1982	Totals By Category
Salaries	17,000	39,000	39,000	39,000	\$ 134,000
Capital Equipment	500	1,000	1,000	2,000	4,500
Components, sub-contracts printed circuit boards, painting, plating, etc.	3,000	12,000	18,300	5,000	38,300
Travel, telephone, telex, shipping, customs, etc.	4,700	6,000	7,000	19,500	37,200
Office supplies, postage, printing, photos, etc.	1,100	1,000	1,000	1,500	4,600
Telecommand station, ground systems, computers, test equipment, etc.	1,000	1,800	1,500	3,000	7,300
Test expenses and contingency	0	2,000	5,000	10,000	17,000
"Intern" Program	4,000	7,000	7,000	7,000	25,000
Totals By ½ Year	31,300	69,800	79,800	87,000	\$ 267,900

the software that served the Phase III telecommand station network; Ron became our IPS "guru". Clarke Greene (K1JX) and Ed Kalin (K1RT) were detailed by the ARRL to assist with OSCAR 8 construction. Clarke returned to AMSAT as one of our key engineers in the construction of Phase IIIA. Will the next Jan King come from F, ZL, JA, or ZS? Only time will tell.

The modest funds in the budget to support interns are to cover per diem for living expenses and a limited amount of travel. If this program proves to be popular, AMSAT might find it expedient to have a "dormitory" in the form of an apartment convenient to AMSAT's laboratory. An allowance for this possibility has been included in the budget.

How Can We Raise \$270,000 Over the Next Two Years? The needs are clear, but the solution will not be easy. The first \$10,000 came in as "sympathy" offerings in June, but the river seems to have dried up. I want to thank Joe Schroeder (W9JUV) for his impassioned editorial pleas on our behalf in the July, 1980 issue of *Ham Radio*. In an article on page 45 of the July *QST*, Steve Place (WB1EYI) tells of what happened and answers many of the burning questions. I suggest that you all re-read these words and carry them to the rest of the amateur radio community. We need their help.

Dick Baldwin (W1RU), the General Manager of the ARRL, in his July, 1980 editorial in *QST* told us to press on and persist. Contacts with Dick, Harry Dannals (W2HD), Jay Holladay (W6EJJ), "Chappie" Chapman (W1QV) and a number of other members of the ARRL "family" have now come to fruition. The ARRL Board, meeting in Seattle in July, passed two resolutions aimed at helping us. The first called on the ARRLF to

establish a program to raise funds for the amateur satellite activities. The second authorized \$10,000 as seed money for a matching fund campaign by the ARRLF. Additional seed money for the matching fund was committed by the Margaret W. and Herbert Hoover Jr. Foundation through Pete Hoover (W6ZH). **WE** -- meaning both AMSAT and the ARRL -- are hard at work to secure additional commitments for matching fund seed money. **YOU** can help. Your donations, large and small, will be matched dollar-for-dollar. All you need to do is write out a check to

The ARRL Foundation - Satellite Fund

and mail it to the ARRL, 225 Main St., Newington, CT 06111.

Remember that \$210,000 of your money for Phase IIIA made a \$1,000,000+ satellite. The labor donated by the "hard-core", and the industrial and commercial donations matched every dollar with the equivalent of at least four dollars more. With the support of the matching fund, you now have the opportunity to make every dollar you give have the leverage of ten!

On the international front, we are seeing our colleagues raising their share. From AMSAT-UK and USKA (Switzerland) we hear of Phase IIIB fundraising campaigns. The IARU Region I has made another commitment to AMSAT-DL. Substantial contributions have come from South Africa and New Zealand. Commitments have been received from our Japanese affiliate, JAMSAT. To the AMSAT membership I offer the following challenge -- will **YOU** continue your support? Will **YOU** help to raise money? Will **WE** have a long-term, continuing program or will our loss of Phase IIIA have been in vain?

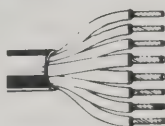
BELDEN

RG8/u
Dbl. Shield



Part
Number
9888

MHz	db/ 100 ft.	db/ 100 m
50	1.2	3.9
100	1.8	5.9
200	2.6	8.5
300	3.3	10.8
400	3.8	12.5



8448

RG8/u
Foam .81VF



8214

50	1.2	3.9
100	1.8	5.9
200	2.6	8.5
300	3.3	10.8
400	3.8	12.5

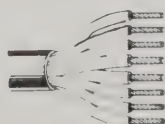
No. of Cond. — 8
AWG (in mm) —
6-22, (7×30),
2-18, (16×30), (1.19)

RG8/u
Regular .77 VF



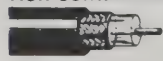
8237

100	2.0	6.6
200	3.0	9.8
400	4.7	15.4
900	7.8	25.6



9405

RG8/u
Non-contaminating



8267

100	2.0	6.6
200	3.0	9.8
400	4.7	15.4
900	7.8	25.6

No. of Cond. — 8
AWG (in mm) —
2-16, (26×30)
6-18 (16×30), (1.17)

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Comets

UOSAT, a satellite for science, is shown below as it appeared in the *JAMSAT OSCAR Newsletter*. AMSAT-UK is constructing it. Present plans call for a September 1981 launch. More details are given on page 4 in this issue of *ORBIT Magazine*.





Akio Fujii, 'Aki', JA7IE, is located at Akita, Japan, 140 31'E, 38 13'N and is an avid OSCAR DX operator, being active on Modes 'A', 'B' and 'J' using CW, SSB, and SSTV.

Aki runs an IC 201, has a Belcom linear, a Drake R4C plus U310 PR1, to a formidable antenna system consisting of a pair of eight element crossed Yagis on '2', a pair of Helixes on '70', and a three element Yagi on '10', as seen on the accompanying photographs.

Aki first became active using AMSAT-OSCAR 6, and has worked AP2, CR9, DU, G, HL, H44, JA, KG6, KH6 (Kure), KL7, OH, P29, SM, UA1-Ø, UL7, VE, VK, VS6, VU, W7, YB, 9M2, etc. a mouth watering array of DX that would even do credit to a twenty meter operator!

Aki has won numerous satellite awards, AJD, WAJA, JCC-100 and JCC-200 from Japan, and WVE, RS1/RS2, and MJC internationally, and for QRL keeps a book store in Akita.

WORLDWIDE SATELLITE ACTIVITY

By Pat Gowen,* G3IOR

AMSAT-OSCAR operators are invited to send a write up of their station, a photograph of station and antennas, with a brief write up on DX and modes worked on OSCAR to G3IOR, for possible inclusion in future issues of *ORBIT* Magazine.

A very high level of OSCAR activity is evidenced from Poland by Adam Sucheta, SP9DH, who is probably the most active of all SP's. Indeed, if one listens to any orbit in the European general area and does not hear SP9DH, one suspects receiver or antenna troubles! Below is the Polish Satellite DX Marathon with placing scores given by 250 points per Continent, 50 per DXCC Country, and 10 points for each different station worked on any mode, any satellite.

CALL	POINTS	WAC	DXCC QSL/QSO	WAZ QSL/QSO	STATIONS	MODES	BEST DX	DX(km)	DATE
SP9DH	17,520	4	59/76	16/20	1.272	A B J	JH3GCN	8.635	16Jan73
SP9EKB	8,900	4	49		545	B J	W4AIT	7.6000	18Feb75
SP9ADU	7,880	4	33/50	8/10	438	A B	W2BXA	6.800	11Jan75
SP9EGM	4,780	4	38		208	B	K9AQP/1	6.500	22Jan75
SP2HV	4,490	4	33		184	A	KL7MF	6.700	24Dec72
SP7DCG	4,180	3	30		193	A B	W1WM	6.400	19Dec74
SP9ANH	4,030	3	31		172	A B	?		Jan73
SP9AI	3,990	3	35		149	A	K2GUG	6.800	09Nov72
SP1JX	3,760	3	31		146	A B	W2WD	6.400	29Nov72
SP2DX	3,500	3	35		100+	A	JA8PL	7.900	05Nov72
SP4BEU	3,290	2	28		139	A	UL7GBD	4.000	25Jul78
SP9EVP	3,270	3	2/28	1/6	112	A	W8DX	7.200	13Nov78
SP2AOZ	3,250	3	30		100+	A B	?		12Nov72
SP9AOA	2,630	3	20/25		63	A	5T5CJ	4.400	19Aug77
SP9GKM	2,570	2	12/23		82	A	UL7GBD	4.100	03Jan76
SP9FG	2,510	3	22		66	B	VE3BNO	7.300	20Aug75
SP9PBZ	2,450	4	12/20		45	A B	W2BXA	6.800	17Mar73
SP8AOV	2,420	3	22		57	A	UA0LFK	7.400	77
SP9DSM	2,400	3	25		40	A B	CN8BO	3.000	20Jan73
SP9BCH	2,350	2	25		60+	A	5B4AZ	2.000	77
SP9AAJ	2,150	3	20		40	A	TU2EF	5.100	Nov.75
SP9BGS	2,050	1	20		80	A	EA6AU	1.600	17Oct76
SP9GVD	2,040	2	16		74	A	6W8AB	3.200	05Nov75
SP9CSO	1,950	2	19		50+	A			Dec75
SP1ADM	1,850	2	19		40	A	4X4UF	3.000	03Nov78
SP2DDV	1,750	1	20		50	A	EI9V	1.600	17Mar76
SP6LB	1,640	2	17		29	B	?		76
SP1CNV	1,620	2	16		32	A	RA9MWW	3.000	24Dec72
SP9ZAA	1,570	2	14		31	A B	RA9MWW	3.200	31Jul75
SP4ERZ	1,270	1	17		17	A	?		
SP6ANY	1,170	1	15		17	A	YU3OV		21Jan80

*Author's address given on page 40.

Radio Transmissions from Outer Space

Part I of this informative discussion appeared in the March issue. Here, the higher frequencies, up to about one GHz, are described in detail. While the author is unable to monitor all of the bands completely, the information supplied should provide a suitable guide to allow those amateurs interested in seeking activity to find it. The author would appreciate any input on these and other transmissions monitored.

By Gregory Roberts,* ZS1BI

Before discussing any new frequency bands, a little additional information on the bands covered in Part I is in order. It was announced that the Soviet SALYUT manned missions make use of 142.40 MHz and 143.625 MHz and since these frequencies are just below the amateur two-meter band, a modified two-meter converter can be used. Whether or not these frequencies are used over areas outside the USSR is not known. It is probably worth monitoring them when there are two manned Soviet craft in orbit because there may be intercraft communication.

The second important item is that the TRANSIT system, developed and maintained by the United States Navy, will be operational until at least 1995. After this date there is a possibility that the system will be taken over and maintained by civilian authorities. As there are ten to twelve reserve satellites in storage on the ground, the future of the TRANSIT system is ensured for many years to come. It is not being phased out as reported earlier. It frequently happens that the orbital planes of satellites in the TRANSIT system overlap and cause interference to one another. When this happens, one or more are switched off, and if necessary, reserve satellites activated. This means that two additional satellites have to be added to the list given in Part I, namely 7381A (currently silent) and 77107A (operational).

In covering new bands it is reasonable to assume that there may be more than one satellite using a particular frequency. It would be rather expensive to equip for a "once only" frequency by the respective space agencies. For various reasons some of these "restricted" frequencies become public knowledge even though the space agency or government would prefer they remain known only to those with "a need to know." We can be assured that there are numerous frequencies that are classified. Satellite trackers in the United States have a much better chance of picking up these unannounced

frequencies as the majority of data collection stations are now situated in the United States. It is only when the satellite is in range of such a station that its transmitter will be activated to do a high-speed dump of the data collected over say the previous orbit. The satellite is probably silent over the rest of the world, recording what it sees and hears. These remarks obviously also apply to the Soviet Union and China.

The Soviet Union is very reluctant to give out frequency data as it would indicate a poor state of the art in the USSR if all their space transmissions were confined to the HF bands and an occasional VHF or higher frequency, so whenever a new Soviet frequency is discovered, it is probably worthwhile to pay a little more attention to the frequencies around the discovered one. This is a slow business, but think how exciting it is to be able to identify a satellite! It is for this reason that I am listing frequencies known to have been used, even if the particular satellite is now silent. I cannot possibly monitor all bands and the more eavesdroppers there are the better the chance of "discovering" something. Obviously for detective work on satellites a spectrum analyzer would be a very useful asset but not many amateurs have these. I will, of course, be delighted to receive any reports of satellites or signals heard on any of the bands mentioned.

Returning now to our examination of the spectrum, the next portion covers the 162 MHz band. In the early stages of developing the TRANSIT system, the frequency combination of 54 MHz, 162 MHz, 216 MHz and 324 MHz was used and it is possible that one or more of these satellites may still be transmitting. What makes it more worthwhile to build a receiving set-up for around this region is the fact that the Soviet Union uses 166 MHz. At least three satellites are known: Cosmos 777, Cosmos 929 and Soyuz 20. It is likely that more satellites use it.

*Author's address given on page 40.

Continuing upwards to about 200 MHz, it is found that there is not much activity. The USSR used frequencies of 183 MHz for their lunar probes and 192 MHz for some Soyuz missions. China used 180 MHz for China 4, so it would appear that this is not a band used by the United States and there does not appear to be much recent Soviet activity.

There has been a fair amount of activity in the region of 200 to 300 MHz but most of it has been related to the manned missions of the United States. For example, the Mercury, Gemini, Apollo and Skylab missions. Early TIROS and ESSA weather satellites used this portion for cloud cover pictures of the earth but the satellites have all been deactivated. Despite this, it would appear that this portion is favored for transponders. Two examples are LES 6 and TACSAT which each carried a transponder covering 225 to 400 MHz, with LES 6 having a beacon frequency of 254 MHz. A currently operational system is MARISAT which employs three geostationary satellites. Each carries several transponders or repeaters, one of which operates from 248 to 260 MHz. Marisat 1 is situated over 15 degrees West longitude, Marisat 2 over 183.5 degrees West and Marisat 3 over 287 degrees West with Marisat 1 and 2 being primary satellites and Marisat 3 secondary. These satellites are in daily use and the transponder mentioned can carry one voice and 44 teletype channels or 14 voice channels. They are used for communications between shore and ships. Since this system is operational and increasing in use, it might be useful to build receiving equipment for this portion of the spectrum.

There appears to be virtually no activity between 300 to 400 MHz, apart from the 324 MHz of the early TRANSIT satellites. However, 400 MHz is relatively active and is used by navigational satellites as well as several scientific satellites. For example, most of the Japanese satellites transmit on 400 MHz as well as 136 MHz. The following satellites are known to have used this band:

TRANSIT development/operational system: 6322A, 6349B, 6426A, 65109A, 6624A, 6641A, 6734A, 6792A, 6812A, 7067A, 7381A, 7599A, 7689A, 77106A. These satellites used the combination of 150 MHz and 400

MHz and exact frequencies for the currently operational satellites are 149.988 MHz and 399.968 MHz. Most of the launches since 1967 are still operational with some in "stand-by" status.

OGO Series: These transmitted on 400.250 MHz and 400.850 MHz and this series has now been discontinued. Five satellites were launched of which one has decayed, leaving 6451A, 6581A, 6649A and 6951A still orbiting but probably all silent.

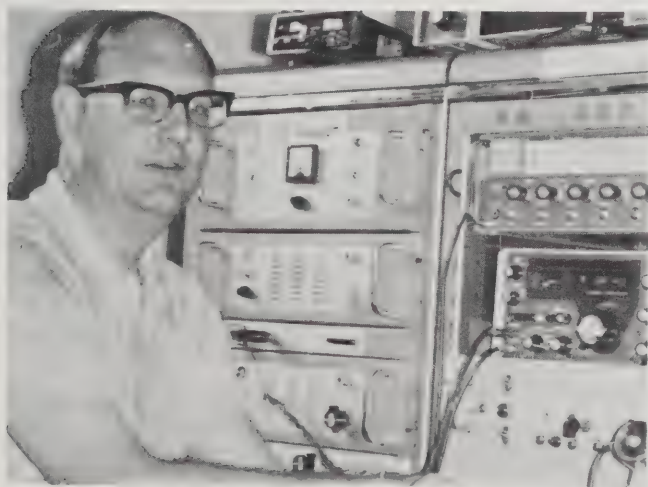
TIMATION Series: These were used to develop new techniques for the distribution of time signals and were probably part of the Transit development program and transmitted on 400 MHz. Two examples are 6753F and 6982B. The former is probably silent but the latter may still be transmitting as it is still active on the 136 MHz band.

ISIS series: Two satellites in this ionospheric sounding program were orbited and transmitted on 401.750 MHz. Both satellites still transmit on lower frequencies so this frequency might still be heard when it is commanded on. The satellites to watch are 6909A and 7124A.

TANSEI series: These satellites are launched by Japan and all have used 400.500 MHz, except for the latest launch, 8015A, which used 400.450 MHz. Other satellites in this series are 7111A, 7408A, and 7712A, the last one having already decayed.

IDCSP series: This USA launched series for Defense Communication purposes has seen twenty-six satellites placed in near geosynchronous equatorial orbits. Since the series were solar powered it is quite likely that one or more may still be transmitting. The launches in this series were 6653, 6703, 6766 and 6850 where for example 6653 signifies the 53rd launch in 1966. The frequencies used are as follows: 401.0125 MHz, 401.0375 MHz, 401.0625 MHz, 401.0875 MHz, 401.1125 MHz, 401.1375 MHz, 401.1625 MHz, 401.1875 MHz, 401.2125 MHz, and 401.2375 MHz.

SOVNAV Series: The Soviet Navigational System is currently operational and some of the transmitting satellites are 76122A, 7713A, 7762A, 7822A, 7834A, 7828A, 7853A, 7926A, and 7930A. New satellites are continually being added to this system and not all satellites may be transmitting at any one time. The frequencies used are 399.90 MHz, 399.933 MHz, 399.968 MHz, 400.00 MHz, and 400.10 MHz. In this band only a continuous carrier is transmitted with the actual telemetry being on 150 MHz.



Greg Roberts, ZS1BI, shown here at his listening post.

OTHER SATELLITES: Approximately thirty other satellites have also used this band, the most recent ones being 7619A (JISS-1) on 400.90 MHz, 7814A (Exos 1) on 400.45 MHz, 7818A (JISS-2) on 400.90 MHz and 7914A (Corsa B) on 400.45 MHz. Other satellites that may still be operational are 6946B (OV5-6) on 400.50 MHz, 7180A (Shinsei) on 400.695 MHz, 7265A (Copernicus) on 400.550 MHz. China has also used the frequencies of 393.0 MHz and 397.0 MHz. I have not paid too much attention to the 400 MHz band, apart from the Transit and Soviet navigational satellites, but it would appear that this band deserves careful watching.

Continuing upward in frequency the next band of activity occurs around 466 MHz. This is still actively used by several satellites and there may be a worthwhile amount of activity, possibly from the Soviet side. The following are some of the spot frequencies that have been used.

6718A	Cosmos 144	461.50 MHz	weather picture transmissions
6739A	Cosmos 156	464.00 MHz	weather picture transmissions
67102A	Cosmos 184	466.50 MHz	weather picture transmissions
6937A	Nimbus 3	466.00 MHz	weather picture transmissions
7433A	SMS-1	468.825 MHz	
7565A	Soyuz 19	463.00 MHz	
75100A	Goes 1	468.825 MHz	
75111A	China 4	480.0 MHz	
7748A	Goes 2	468.825 MHz	
7862A	Goes 3	468.825 MHz	
77108A	Meteosat 1	468.875 MHz	
77108A	Meteosat 1	468.925 MHz	

From this band up to about 700 MHz there appears to be no satellite activity at all, with the next band occurring at around 800 MHz. This band is used by the Soviet MOLNIYA 1 series and is officially described as a "communications repeater and space relay system" containing a 40-watt primary transmitter, two backup transmitters, a command receiver and several antennas. Since the program was started in 1965 nearly fifty satellites have been launched and three satellites are operational at any time. The orbits are very elliptical, ranging from about 400 to about 40000 kilometers and the orbital period is just under twelve hours. The system is so orientated and operated that the apogee always occurs above the USSR on one pass and over North America on its second pass, so it is trackable

from the United States. The exact frequency has not been stated and is merely given as 800 MHz. Since this is in the range of conventional UHF television sets it might be rewarding to set up a high gain antenna with suitable preamplifier and scan the region of 800 MHz. In this way it was possible to determine the frequency used by the EKRAN series of satellites. These are also Soviet communication satellites that have been placed in geostationary orbits and one or two should be in range of the west coast of the United States. The actual frequency used is 714 MHz with a bandwidth of 16 MHz and it is relatively easy to receive the pictures transmitted. Unfortunately the sound is contained within the picture information and no attempts have been made to extract it as not many people understand Russian! Approximately a dozen amateur stations in South Africa have picked up these transmissions.

Another frequency that was used for television transmissions was 860 MHz employed by the Applications Technology Satellite No. 6 when it was in geostationary orbit above Lake Victoria in Central Africa and beaming transmissions to villages in India as part of the SITE program. There were several reports of these signals being received in South Africa and from as far afield as England. The satellite has subsequently been moved back to its position at 140 degrees west and the current status of the 860 MHz transmitter is unknown. It is likely that developing nations will use this part of the spectrum for television transmissions from geostationary satellites.

The next bit of activity takes place around 960 MHz. In the early days this was used by the United States for its Ranger and Pioneer space missions but subsequently the frequencies used have been much higher. The Soviet Union still appears to favor this band and the following are some known frequencies:

Venera space probes on 922.763 MHz, Mars probes on 928.4 MHz, the PROGNOZ series on 928.4 MHz and several unmanned Soyuz missions on 922.75 MHz as well as 926.06 MHz. Since this band appears to be mainly used by space probes it will probably not be worthwhile to develop equipment for it.

In the next part of this series an examination will be made of the spectrum above 1 GHz. I have attempted to give some indication of possible activity and I would appreciate any comments or reports. I have attempted to compile as comprehensive a list of operational satellite frequencies back to 1957 and there are still numerous gaps which need to be filled. Any assistance in this direction will also be much appreciated.



Satellite News: The news bulletin of satellites, spacecraft and space activity is available in four editions: *Space Objects Digest*, *Military Space Digest*, *Space Operations Review* and *Space Systems Digest*. The price is 25 cents per issue: subscribe for as many issues as you like. Payments and orders by International Money Order, cash or Check. Please add \$2 to personal checks for UK bank charges. Orders should be sent to: Geoffrey Falworth, 12 Barn Croft, Penwortham, Preston PR1 0SX, England.

Satellite Log

By Geoffrey Falworth

Satellite Log features launches into orbit since the beginning of 1980. The satellite name is that assigned by the launching agency (the international designation is in parenthesis) and the orbit (period, inclination to Earth's equator, apogee height, perigee height) is for shortly after launch; later maneuvers may modify this orbit. Transmissions are those which are publicly reported or assumed from the type of spacecraft involved.

Cosmos 1149 (1980-01A) launched on 1980 Jan 9; initial orbit: 92.30 min, 72° 87', 420 km, 353 km; transmissions: none reported. Recoverable reconnaissance satellite.

Molniya 76 (1980-02A) launched on 1980 Jan 11; initial orbit: 736.51 min, 62° 84', 40848 km, 432 km; transmissions: 800 to 1000 MHz 3400 to 4100 MHz. Molniya 1-class communications satellite.

Cosmos 1150 (1980-03A) launched on 1980 Jan 14; initial orbit: 105.01 min, 82° 95', 1017 km, 971 km; transmissions: 150.000 MHz. Navigation satellite.

Fleetsatcom 3 (1980-04A) launched on 1980 Jan 18; initial orbit: 1436.09 min, 2° 68', 35923 km, 35657 km; transmissions: 244 to 270 MHz, 2252.500 MHz, 2262.200 MHz. Communications satellite leased to U.S. Navy to be located over longitude 22° West.

Cosmos 1151 (1980-05A) launched on 1980 Jan 23; initial orbit: 97.78 min, 82° 52', 666 km, 637 km; transmissions: none reported. Earth resources satellite.

Cosmos 1152 (1980-06A) launched on 1980 Jan 24; initial orbit: 89.76 min, 67° 15', 375 km, 149 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1153 (1980-07A) launched on 1980 Jan 25; initial orbit: 105.00 min, 82° 93', 1020 km, 967 km; transmissions: 150.000 MHz. Navigation satellite.

Cosmos 1154 (1980-08A) launched on 1980 Jan 30; initial orbit: 97.50 min, 81° 22', 645 km, 631 km; transmissions: none reported. Military weather satellite.

Cosmos 1155 (1980-09A) launched on 1980 Feb 7; initial orbit: 90.45 min, 72° 87', 397 km, 195 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Operations 2581 (1980-10A) launched on 1980 Feb 7; initial orbit: 91.85 min, 96° 98', 503 km, 225 km; transmissions: none reported. Reconnaissance satellite.

Navigation Development Satellite 5 (1980-11A) launched on 1980 Feb 9; initial orbit: 715.23 min, 63° 72', 20147 km, 20083 km; transmissions: 1227.600 MHz, 1575.420 MHz, 2227.500 MHz. Navstar global positioning system satellite.

Cosmos 1156 (1980-12A) launched on 1980 Feb 11; initial orbit: 114.64 min, 74° 02', 1475 km, 1400 km; transmissions: none reported. Military communications satellite.

Cosmos 1157 (1980-12B) launched on 1980 Feb 11; initial orbit: 114.85 min, 74° 02', 1477 km, 1417 km; transmissions: none reported. Military communications satellite.

Cosmos 1158 (1980-12C) launched on 1980 Feb 11; initial orbit: 115.05 min, 74° 02', 1478 km, 1435 km; transmissions: none reported. Military communications satellite.

Cosmos 1159 (1980-12D) launched on 1980 Feb 11; initial orbit: 115.26 min, 74° 02', 1481 km, 1453 km; transmissions: none reported. Military communications satellite.

Cosmos 1160 (1980-12E) launched on 1980 Feb 11; initial orbit: 115.47 min, 74° 02', 1486 km, 1467 km; transmissions: none reported. Military communications satellite.

Cosmos 1161 (1980-12F) launched on 1980 Feb 11; initial orbit: 115.71 min, 74° 02', 1505 km, 1469 km; transmissions: none reported. Military communications satellite.

Cosmos 1162 (1980-12G) launched on 1980 Feb 11; initial orbit: 115.94 min, 74° 02', 1523 km, 1472 km; transmissions: none reported. Military communications satellite.

Cosmos 1163 (1980-12H) launched on 1980 Feb 11; initial orbit: 116.20 min, 74° 02', 1545 km, 1472 km; transmissions: none reported. Military communications satellite.

Cosmos 1164 (1980-13A) launched on 1980 Feb 12; initial orbit: 736.87 min, 62° 82', 40858 km, 435 km; transmissions: 2292 MHz. Early warning satellite.

Solar Maximum Mission 1 (1980-14A) launched on 1980 Feb 14; initial orbit: 95.81 min, 28° 51', 569 km, 560 km; transmissions: 2287.500 MHz. Solar research satellite (to be retrieved by Space Shuttle).

MS-T4 (1980-15A) launched on 1980 Feb 17; initial orbit: 95.75 min, 38° 68', 602 km, 519 km; transmissions: 136.725 MHz, 400.450 MHz, 2280.500 MHz. Japanese technology satellite.

Raduga 6 (1980-16A) launched on 1980 Feb 20; initial orbit: 1436.37 min, 0° 30', 35851 km, 35740 km; transmissions: 3420 MHz, 3510 MHz, 3600 MHz, 3690 MHz, 3780 MHz, 3870 MHz, 3895 MHz, 7250 to 7750 MHz. Communications satellite at Stationar 2 location over longitude 35° East.

Cosmos 1165 (1980-17A) launched on 1980 Feb 21; initial orbit: 89.78 min, 72° 88', 354 km, 172 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Experimental Communications Satellite 2 (1980-18A) launched on 1980 Feb 22; initial orbit: 1441.59 min, 0° 50', 36402 km, 35393 km; transmissions: 136.112 MHz, 3940 MHz, 4075 MHz, 4080 MHz, 31650 MHz. Japanese communications satellite; transmissions ceased 8 sec after apogee injection rocket motor fired.

Operations 7245 (1980-19A) launched on 1980 Mar 3; initial orbit: 107.11 min, 63° 03', 1150 km, 1035 km; transmissions: none reported. U.S. Navy ocean surveillance satellite.

EP 1 (1980-19C) launched on 1980 Mar 3; initial orbit: 107.55 min, 63° 49', 1169 km, 1051 km; transmissions: none reported. U.S. Navy electronic surveillance satellite.

EP 2 (1980-19D) launched on 1980 Mar 3; initial orbit: 107.55 min, 63° 49', 1170 km, 1052 km; transmissions: none reported. U.S. Navy electronic surveillance satellite.

EP 3 (1980-19G) launched on 1980 Mar 3; initial orbit: 107.55 min, 63° 48', 1169 km, 1052 km; transmissions: none reported. U.S. Navy electronic surveillance satellite.

Cosmos 1166 (1980-20A) launched on 1980 Mar 4; initial orbit: 90.32 min, 72° 84', 381 km, 198 km; transmissions: 19.989 MHz. Recoverable reconnaissance satellite.

Cosmos 1167 (1980-21A) launched on 1980 Mar 14; initial orbit: 93.31 min, 65° 03', 445 km, 429 km; transmissions: none reported. Ocean radar reconnaissance satellite.

Cosmos 1168 (1980-22A) launched on 1980 Mar 17; initial orbit: 104.92 min, 82° 95', 1015 km, 964 km; transmissions: 150.000 MHz. Navigation satellite.

Cosmos 1169 (1980-23A) launched on 1980 Mar 27; initial orbit: 94.53 min, 65° 84', 515 km, 477 km; transmissions: none reported. Electronic surveillance satellite.

(continued on page 39)

LETTERS



AMSAT's Magazine

Congratulations on *ORBIT*, an excellent magazine, which has evolved from the AMSAT Newsletter. I find that the nets and the Magazine provide very good coverage of the amateur satellite scene.

Enclosed is a money order to cover renewal of my life membership. I believe this is a good way to support the amateur space program and ensure the continued progress towards getting our Phase III bird built and in orbit. From time to time I will be able to contribute financially and hope to be talking some of our local clubs into also supporting AMSAT.

I have operated only Mode B since getting started on the satellite in August 1976 and I enclose a picture of the antenna system. An 11-element Yagi for the uplink and a homebuilt five element quad for the downlink are mounted about 12 feet off the ground and the two TV rotors provide az/el rotation. The rig is an Echo 70 for the uplink and I receive the downlink signals on a Multi 2000.—*VE3EFX*

Have just paid my life membership fee, thought I would write to congratulate you on a very interesting first issue of *ORBIT*. Am looking forward very much to receiving future editions.—*G8IFF*

Remorse?

Whatever Jan felt on May 23rd, I'm sure it was not remorse (*ORBIT*, June/July, page 5). Why should he have felt guilty or repentant? He did a great job. Hope you didn't mean it.

Like the new format.—*VE3HD*

W9VI

Our Father, C. Keith Mason, W9VI, died June 24, 1980, we know that he was very interested in AMSAT, and we received several memorials in his name with no preference marked.

We as his children know that he would want AMSAT to have this memorial to use as they see fit.

As AMSAT Life Member 195 this will be the final contribution that can be made in our fathers name. It is not a lot of money, but we hope that it can be used in some way - no matter what the goal.

We don't know much about AMSAT, but he did tell us that the last launch was a disaster, so we hope that this can be used to help get the next satellite up.—*The C.Keith Mason Family*

TRS-80 Program

I was quite sorry to hear about the loss of the Phase III satellite, I would like to become more involved by becoming a member of AMSAT. I would like to know of a source for programs written for the Radio Shack TRS-80 that are designed for satellite tracking and orbit computation.

I am currently working with a program which might be used to read and log the Morse code telemetry signals.—*WB8TOE*

Contact the AMSAT Computer/Calculator User group, P.O. Box 338, Ashmore, IL 61912—*Editor*

QST and Satellite DXCC

The announcement in June 1980 *QST* regarding satellite DXCC, raises some important questions regarding AMSAT and its future.

It is readily apparent that AMSAT directors and the DXCC of ARRL made a decision on satellite DXCC without trying to find out how the amateur ranks, particularly the AMSAT members, might feel about the modification to the satellite DXCC award.

W8DX expressed one important opinion and that is OSCAR's 6, 7 and 8 all favored northeast USA and Europe for DXCC possibilities. Many others eagerly awaited Phase III so that they too might be able to achieve satellite DXCC.

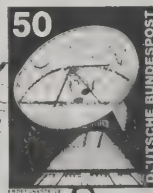
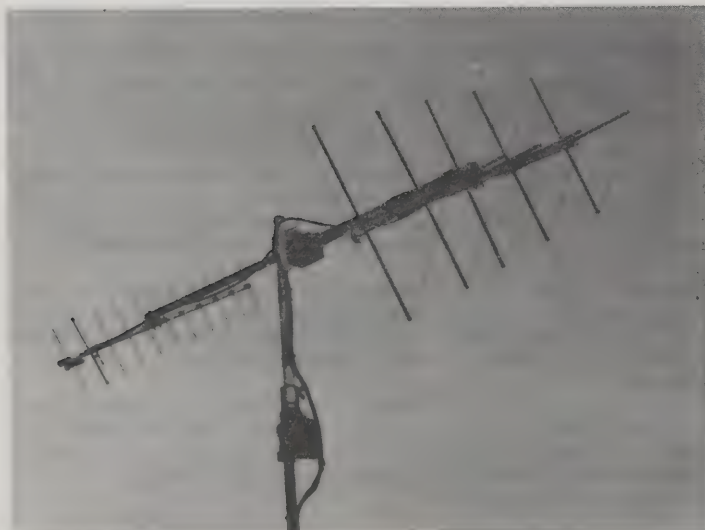
It is really strange that with Phase III in the mill for such a long time, the modification to the DXCC award was not released until June 1980 *QST*, JUST ABOUT THE TIME Phase III was to be launched.

All those fancy words about the award only being made for contacts through polar-sun synchronous satellites of altitudes less than 1500 miles sounds like a first class "snow job". Was not Phase III classified as a satellite? And furthermore, who is going to launch Phase II satellites of the OSCAR 6, 7 and 8 variety in the future? ARRL? AMSAT?

Therefore only those amateurs who have already achieved satellite DXCC, will make it. All the others with totals well up towards 100 countries can go whistling for their efforts to date, with nothing much to look forward to.

Tom Clark, W3IWI, expressed the view that he didn't want the Phase III satellite to be a contest machine. He has nothing to worry about. It takes a fair amount of money to get equipped for Phase III and that does not include all those DXers one hears on 10, 15, 20, 40 and 80. I believe there is a very limited number of hams operating via satellites.

I sincerely hope that AMSAT and the DXCC of ARRL will review their decision and find a way to change it, so that when we do get a Phase III satellite in orbit, old satellite DXers will not have to start from scratch—*K4UAS*



An eleven-element Yagi for the uplink and a homemade five-element quad for the downlink are mounted 12 feet off the ground. Two TV rotors control the heading. The system is located at VE3EFX.

Tracking Satellites

It is a great pity that Phase IIIA was a failure. The orbit of Phase IIIA is similar to the orbit of Molnia (USSR) satellite. It is very useful for practicing tracking Phase IIIB, unfortunately I do not know the frequency of the Molniya satellite. If you know the frequency, would you be kind enough to print it in *ORBIT* Magazine?—JA2WO

See "Satellite Log" on page 31—Editor

"KISS"

I think it appropriate for me to say, as a member of AMSAT, that I am opposed to making Phase IIIB any more sophisticated a bird than that planned for Phase IIIA. I can see them now figuring on 1296 and a zillion other combinations no good for the majority of us. KISS. As they say, "keep it simple, stupid". I think I represent a majority when I say that there is too much an attempt to make the new birds showpiece of technical ability and not practicality. Maybe I'm wrong, but don't think so.—W9JJ

Now That the Water Has Settled. . . .

Enough time has passed for some of the dust (water?) to have settled following the sad events of 23 May that I feel some feedback from the membership of AMSAT might be in order. My feelings over the loss of Phase IIIA are probably similar to those at AMSAT headquarters, a combination of deep disappointment mixed with frustration. After the record of achievement of OSCAR's 5 through 8, I guess we all had become a little complacent and maybe forgotten that Murphy's law is always out there trying to get us. Having been rudely returned to earth (no pun intended!), my feelings (and those of all AMSAT members with whom I have spoken) are that we must look to the future and push on with Phase IIIB. The support I feel from others I talk to is universal, both in terms of moral support and, even more important, financial support for the amateur satellite program. I would also like to express my appreciation for all the hard work put in by all the members of the development team around the world. Their accomplishment isn't really diminished by the launch failure - they still had a working satellite ready to go, on time (and within budget!). Certainly the fact that W3GEY will be staying with AMSAT, along with DJ4ZC and the rest of the team, is a very positive development in terms of the future of the amateur satellite program. I personally have great confidence in their (our?) ability to recover and produce an even better Phase IIIB.

I believe that in order to maintain the enthusiasm and support of the users, that first priority should be given to orbiting a replacement satellite with at least the capability of Phase IIIA at the earliest possible date. I would favor a Phase IIIA clone (WA2LQQ's term) a year from now over a wonderful new machine with a 23 to 70 cm transponder and all sorts of other goodies in two or three years. My reasons are not entirely selfish, although I certainly was looking forward to all that 70 cm DX! Given the current state of OSCAR 7, it is not inconceivable that we could in the not too distant

future find ourselves with only one operating bird, and that in a 570 mile orbit which is nothing to write home about in terms of either range or communications time available. I fear that this would lead a fair number of users to forget about satellite operation (and about AMSAT!) and go back to tropo, EME, or (heaven forbid!) HF. As an advanced class licensee with over 17 years on the air, I find more satisfaction in satellite operation than in any other phase of ham radio that I can think of offhand, and you will definitely have my continuing support, regardless of the eventual launch date of Phase IIIB. How many supporters would we lose, though, if we don't have a replacement satellite for, say, three or four years?

If, due to circumstances beyond AMSAT's control, the Phase IIIB launch will be delayed to the extent that improvements and modifications to the Phase IIIA design are feasible without impacting the launch date, I have a few suggestions (prioritized!) for enhancements: 1. Some form of selective AGC system which will shut down individual small segments of the passband whenever excessive uplink power is detected in those segments. I believe AMSAT Italiana is working along these lines. I am very concerned about the possibilities for hogging of the downlink by a few high powered stations, leaving those of us who insist on playing by the rules with no way to be heard, short of increasing power to ridiculous levels as well. I think the ideal system would not just limit the downlink power in any passband segment, but actually shut off segments where high uplink signals are detected. This would remove all incentive for those inconsiderate operators to employ more than the necessary ERP. 2. A second transponder, but not one using the 2m up - 70 cm down combination! We have seen from OSCAR 8 Mode J the problems with downlink receiver desense and birdies that result. My suggestion would be a 23 cm to 70 cm translator, since we now have an uplink allocation at 1260 MHz. This would relieve the crowding which will soon exist (I hope) in the 2m satellite allocation, and serve as a stimulus to get large numbers of amateurs active on 23 cm. I'm sure that many stations now active on 70 cm are there as a direct result of OSCAR 7 Mode B, I know I am one of them. 3. I think a 2300 MHz beacon would be a useful experiment. It would seem that it might be especially useful to the AMSAT telecommand stations, given the data rates which might be sustained over such a link.—WB6FCS



Comets

QSLs QSLs QSLs QSLs . . .

via OSCAR-6

JA1
NEZ

AMSAT

news



Southern Africa AMSAT Annual General Meeting

S. A. AMSAT has done extremely well in the few months that it has been in existence. On July 14, 1979, approval was received from AMSAT in the United States to form a group in Southern Africa and the draft constitution was drawn up on the 16th August of that year and from the beginning of September membership of S.A. AMSAT was available to all interested. Six month later, they are now approaching 87 members and are on a sound financial footing.

Two issues of their publication, called *Satellite Communications*, have appeared under the very capable editorship of Hans, ZS6AKV. S.A. AMSAT has received some international recognition and they have good relationships with AMSAT in the States, AMSAT-UK, AMSAT-Holland and AMSAT-DL. They are also affiliated to the South African Radio League. The S.A. AMSAT satellite bulletin performs a very useful function and is becoming increasingly popular and now enjoys almost countrywide coverage with numerous relays onto other frequencies. The net has now been in existence for nearly three years - inherited from Hugh, TU2EF, when he left Africa and it used to operate on Saturdays at 1 P.M. At that time the attendance from South Africa was two or three amateurs. It has now increased to about twenty regular call-in stations on 20 meters, but it is known that the audience is considerably greater, especially now with the relays. In the three years of operation, I cannot recall a Sunday bulletin being missed.

In the future, S.A. AMSAT will continue to grow, and I think that the driving forces behind S.A. AMSAT have a secret ambition that one day South African amateurs will be responsible for a satellite in space. South Africa has the technical capability in its radio amateurs - all we have to do is to find the time required and the rather large sum of money necessary. I do not see S.A. AMSAT attempting this within the next few years, but perhaps by the 1990's we may well have joined the other amateur groups that have designed and constructed satellites. -ZS1BI

AMSAT's Annual Meeting

The Annual Meeting will be held at 8:00 P.M. on Saturday, September 13, 1980 at the NASA Goddard Space Flight Center Employee Recreation Center in Greenbelt, Maryland. The largest Chesapeake area hamfest, the Gaithersburg Hamfest will be held the next day. Why not combine the Annual Meeting with a visit to the hamfest.

Directions to the NASA Goddard Employee Recreation Center: Take the Baltimore-Washington Parkway to the Greenbelt Road exit (Rt. 193), and take Greenbelt Road east 1.5 miles to Soil Conservation Road (on the left). Turn left onto Soil Conservation Road and go 0.1 mile to the first gate you come to on the right. Go through this gate, continue straight following the signs to the Goddard Recreation Center Building.

There will be a forum in the afternoon to discuss future AMSAT plans followed by an AMSAT dinner at 6:00 P.M. at the Goddard Employee Recreation Center. Please let us know if you can join us so that we can firm up reservations.

The 146.235/835 AMSAT repeater will be available for talk-in before the dinner and the meeting. (Please note the new frequency.)

Second Southern Africa Satellite Communications Conference is set for November

Date: Saturday November 1, 1980

Venue: Jan Smuts Holiday Inn,
Kempton Park

Program:

- Determining Satellite orbits by micro-processors and practical approach
- Antenna designs
- Reception of TV satellites
- Russian Satellites - update
- The new Phase III program
- DX on OSCAR 7 and 8
- Scientific Amateur Satellites

Registration

R15 per person for full day

R10 per person for morning session

R 8 per person for afternoon session

Registration includes lunch, teas and coffees and a cocktail party after the conference.

H.M. The Queen's Honours List

It was announced Saturday, June 14, 1980, that Roy Stevens, G2BVN, (Past President of The Radio Society of Great Britain, and Sec. of IARU Region I) has been awarded the M.B.E. by Her Majesty the Queen. This is an honour well deserved by Roy for his 19 years of service to Amateur Radio. — G3AAJ

AMSAT wishes to acknowledge with thanks these generous donations from individuals and organizations:

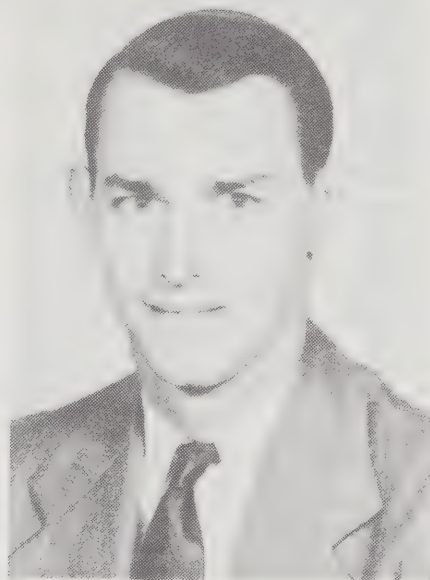
Individuals: Hank Filson, KØSMI, Wichita Kansas, James C. Mankin, N8AKU, Charlottesville, Virginia, James C. McCray, WA3HRJ, Erie, Pennsylvania, Robert W. Barbee, Jr., W4AMI, Memphis, Tennessee, Hugh Compton, W7MKW, Seattle, Washington, Ray Soifer, W2RS, Glen Rock, New Jersey, Charles Wilson Jr., Greensboro, North Carolina, Wilse G. Morgan, KL7CQ, Anchorage, Alaska, Curtis Heuberger, K1CH, Seekonk, Massachusetts, Katashi Nose, KH6LJ, Honolulu, Hawaii, Mark N. Busch, W2GRD, New Brunswick, New Jersey, H.E. Gamache, KH6AIN, Honolulu, Hawaii, John McKee, WB4OFT, Winston-Salem, North Carolina, Harry C. DeMuth, W9FJB, Chicago, Illinois, Richard Eaton, W2SBI, Fayetteville, New York, Lawrence Stoskopf, NØUU, Wichita, Kansas, Robert H. Dilworth, W4LQE, Concord, Tennessee, J. H. Thompson, W1BIH, Torrington, Conn., M.A. Mason, W6KAG, Rancho Palos Verdes California, William D. Cooley, WB2YIK, Vestal, New York, Frank Wiesenmeyer, K9CIS, Decatur, Illinois, Bayman McWhan, W2GAX, Morris Plains, New Jersey, Keith Mason, W9VI, Lincoln, Illinois, W.D. McCaa Jr., KØRZ, Boulder, Colorado, Ed Means, WØVO, Colorado Springs, Colorado, N.W. Smith, W3FNU, Bethesda, Maryland, John Branegan, GM4IHJ, Fife, Scotland, Joe Schroeder, W9JUV, Glenview, Illinois, John J. Erhart, W8SMC, Cincinnati, Ohio, Larry Pittman, WD9EME, Hope, Indiana, George Elliott, VE2LI, Montreal, Canada, Wendell Jackson, W3WW, Annapolis, Maryland, Ted Dames, W2KUW, N. Arlington, New Jersey, John and Ruthe Ferguson, Wayland, Massachusetts, Darryl Dippel, WA5AAO, LaGrange, Texas, C.J. Clark, K4GEX, Carthage, North Carolina, Birger Lindholm, Dalsbruk, Finland, William Tynan, W3XO, Silver Spring, Maryland, Vic Politi, W1NU, Fairfield, Connecticut, Joel Tilley, KA8JTC, Dayton, Ohio, Joseph T. Fenn, WB3AGB, Pittsburgh, Pennsylvania, Nick Laub, WØCA Backus, Minnesota, Warren Taylor II, W6FCS, W. Covina, California, Jim Foster, K7ZFG, Klamath Falls, Oregon, Keith Mason Family (in memory of Keith Mason), Lincoln, Illinois, W.J. English, W7LHI, Sierra Vista, Arizona, Norman A. Williams, K3NW, Fleetwood, Pennsylvania.

Organizations: Trio-Kenwood Communications, Inc., Compton, California, Ham Radio Center, St. Louis, Missouri, Amateur Electronic Supply, Milwaukee, Wisconsin, New Zealand Association of Radio Transmitters, Christchurch, New Zealand, Greater Cincinnati Amateur Radio Association, Cincinnati, Ohio, Local amateurs in Australia Burleigh Heads, Australia, Ten-Tec, Sevierville, Tennessee.

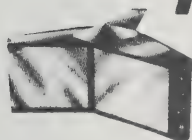
We are especially grieved to report the loss of an AMSAT stalwart.

Charles Keith Mason, 55, W9VI, died suddenly at his home in Lincoln, Illinois, early Tuesday, June 24, 1980.

W9VI was a Life Member of AMSAT and A.R.R.L., held an Extra Class license, and had been licensed for more than 40 years. Keith held many awards including Satellite WAS #3 and a gold medal for operating and using RS1 and RS2. Keith was a native of Illinois having been born in Armington on September 9, 1924. He served in World War II with the Army Air Corps in France. He had been employed by the Admiral Corporation as an Electronic Technician at the plant in Harvard, ILL. for the past 26 years. W9VI was very active in the Amateur Satellite Program beginning with OSCAR 5. There are very few North American satellite users who have not worked W9VI (or W9OII). As an Amateur, his key has fallen silent and the ether no longer resonates to his signal. As a fine human being, though, he will be deeply missed and not soon forgotten.--WA2LQQ



Henry Radio



**YOUR OSCAR
HEADQUARTERS**

There'll be a new AMSAT/OSCAR Phase III satellite — and when it comes, it will open the door to a whole new world of Amateur Satellite Communications for all hams. It's like an exciting new band.

And **HENRY RADIO** is the place to come for all your equipment needs.

For personal assistance, if Phase III and OSCAR are new to you, write, call or drop in and **Jack Somers, WA6VGS** will be glad to help you. Jack is a Life Member of AMSAT, Project OSCAR Member and Member No. 131 of the Mode-J Club.

**Call toll-free 800-421-6631
or locally 213-477-6701
11240 W. Olympic Blvd.
Los Angeles, CA 90064**

Comets

OUR COVER

One of critical operations in the integration of the Phase IIIA Spacecraft with the Ariane launch vehicle was the mounting of the kick motor. Our cover picture was taken in the high bay area at the Centre Spatial Guyanais, wherein the kick motor manufactured by Thiokil is being prepared for mounting into the spacecraft. The motor is first set up on the support stand. This process was underway when the cover picture was taken. It shows the motor suspended above the stand, slowly being lowered into position.

Once the kick motor is in place on the stand, the satellite is lowered onto the kick motor and they are bolted together. The shiny part of the nozzle is aluminium foil put on for thermal purposes.

In the background one can see the portable AMSAT-GOLEM-80, S-100 Based Microcomputer that was used as the range safety computer at the launch site and is now being used to maintain the AMSAT membership list.

The computer is built into a case manufactured by GM Research, contains a power supply, motherboard, a 9-inch tv monitor, a single 5¼ inch floppy disc drive, an 8080 microprocessor, AMS-80, 40k of RAM, 64 x 16 memory mapped video display, keyboard, and a Northstar floppy disc controller.

The following summary is a supplement to the quarterly calendar published by Project OSCAR, Inc. It includes the equations below which project correction for atmospheric drag.

$$\text{AO-7 Period (min/orbit)} = 114.95221 - 3.72833 \times 10^{-7} \times (\text{orbit number})$$

$$\text{Ang. Inc. (deg./orbit)} = 28.7373$$

$$\text{AO8 Period (min/orbit)} = 103.24118 - 3.10166 \times 10^{-6} \times (\text{orbit number})$$

$$\text{Ang. Inc. (deg/orbit)} = 25.810361 - 6.5 \times 10^{-7} (\text{orbit number})$$

ORBITAL PREDICTIONS

BY PROJECT OSCAR INC.

U.T.C. DATE			-- AMSAT-OSCAR 7 --			-- AMSAT-OSCAR 8 --			SCHED. MODE
			TIME (HMM:SS)	DEG.	ORBIT NUMBER	TIME (HMM:SS)	DEG.	ORBIT NUMBER	
MON.	1	SEP. (245)	25:29	79.0	26513	134:25	77.4	12700	A
TUE.	2	SEP. (246)	119:44	92.6	26526	139:14	78.7	12714	A+J
WED.	3	SEP. (247)	19: 3	77.5	26538	0:51	54.1	12727	X
THU.	4	SEP. (248)	113:18	91.1	26551	5:41	55.3	12741	A
FRI.	5	SEP. (249)	12:36	75.9	26563	10:30	56.5	12755	A+J
SAT.	6	SEP. (250)	106:51	89.5	26576	15:19	57.8	12769	J
SUN.	7	SEP. (251)	6:10	74.3	26588	20: 9	59.0	12783	J
MON.	8	SEP. (252)	100:25	87.9	26601	24:58	60.2	12797	A
TUE.	9	SEP. (253)	154:40	101.5	26614	29:47	61.5	12811	A+J
WED.	10	SEP. (254)	53:58	86.3	26626	34:36	62.7	12825	X
THU.	11	SEP. (255)	148:13	99.9	26639	39:26	63.9	12839	A
FRI.	12	SEP. (256)	47:32	84.8	26651	44:15	65.1	12853	A+J
SAT.	13	SEP. (257)	141:47	98.4	26664	49: 4	66.4	12867	J
SUN.	14	SEP. (258)	41: 5	83.2	26676	53:53	67.6	12881	J
MON.	15	SEP. (259)	135:20	96.8	26689	58:42	68.8	12895	A
TUE.	16	SEP. (260)	34:38	81.6	26701	103:31	70.0	12909	A+J
WED.	17	SEP. (261)	128:53	95.2	26714	108:20	71.3	12923	X
THU.	18	SEP. (262)	28:12	80.1	26726	113: 9	72.5	12937	A
FRI.	19	SEP. (263)	122:27	93.7	26739	117:58	73.7	12951	A+J
SAT.	20	SEP. (264)	21:45	78.5	26751	122:46	75.0	12965	J
SUN.	21	SEP. (265)	115:60	92.1	26764	127:35	76.2	12979	J
MON.	22	SEP. (266)	15:18	76.9	26776	132:24	77.4	12993	A
TUE.	23	SEP. (267)	109:33	90.5	26789	137:13	78.6	13007	A+J
WED.	24	SEP. (268)	8:52	75.4	26801	142: 1	79.9	13021	X
THU.	25	SEP. (269)	103: 7	89.0	26814	3:38	55.3	13034	A
FRI.	26	SEP. (270)	2:25	73.8	26826	8:27	56.5	13048	A+J
SAT.	27	SEP. (271)	56:40	87.4	26839	13:15	57.7	13062	J
SUN.	28	SEP. (272)	150:55	101.0	26852	18: 4	59.0	13076	J
MON.	29	SEP. (273)	50:13	85.8	26864	22:52	60.2	13090	A
TUE.	30	SEP. (274)	144:28	99.4	26877	27:41	61.4	13104	A+J
WED.	1	OCT. (275)	43:46	84.3	26889	32:29	62.6	13118	X
THU.	2	OCT. (276)	138: 1	97.8	26902	37:18	63.9	13132	A
FRI.	3	OCT. (277)	37:20	82.7	26914	42: 6	65.1	13146	A+J
SAT.	4	OCT. (278)	131:35	96.3	26927	46:54	66.3	13160	J
SUN.	5	OCT. (279)	30:53	81.1	26939	51:43	67.5	13174	J
MON.	6	OCT. (280)	125: 8	94.7	26952	56:31	68.8	13188	A
TUE.	7	OCT. (281)	24:26	79.6	26964	101:19	70.0	13202	A+J
WED.	8	OCT. (282)	118:41	93.1	26977	106: 7	71.2	13216	X
THU.	9	OCT. (283)	17:60	78.0	26989	110:55	72.4	13230	A
FRI.	10	OCT. (284)	112:14	91.6	27002	115:43	73.7	13244	A+J
SAT.	11	OCT. (285)	11:33	76.4	27014	120:31	74.9	13258	J
SUN.	12	OCT. (286)	105:47	90.0	27027	125:20	76.1	13272	J
MON.	13	OCT. (287)	5: 6	74.9	27039	130: 7	77.3	13286	A
TUE.	14	OCT. (288)	59:21	88.4	27052	134:56	78.6	13300	A+J
WED.	15	OCT. (289)	153:36	102.0	27065	139:43	79.8	13314	X
THU.	16	OCT. (290)	52:54	86.9	27077	1:19	55.2	13327	A
FRI.	17	OCT. (291)	147: 9	100.5	27090	6: 7	56.4	13341	A+J
SAT.	18	OCT. (292)	46:27	85.3	27102	10:55	57.7	13355	J
SUN.	19	OCT. (293)	140:42	98.9	27115	15:43	58.9	13369	J
MON.	20	OCT. (294)	40: 0	83.7	27127	20:31	60.1	13383	A
TUE.	21	OCT. (295)	134:15	97.3	27140	25:18	61.3	13397	A+J
WED.	22	OCT. (296)	33:33	82.2	27152	30: 6	62.6	13411	X
THU.	23	OCT. (297)	127:48	95.8	27165	34:54	63.8	13425	A
FRI.	24	OCT. (298)	27: 6	80.6	27177	39:41	65.0	13439	A+J
SAT.	25	OCT. (299)	121:21	94.2	27190	44:29	66.2	13453	J
SUN.	26	OCT. (300)	20:39	79.0	27202	49:16	67.4	13467	J
MON.	27	OCT. (301)	114:54	92.6	27215	54: 4	68.7	13481	A
TUE.	28	OCT. (302)	14:13	77.5	27227	58:51	69.9	13495	A+J
WED.	29	OCT. (303)	108:27	91.1	27240	103:39	71.1	13509	X
THU.	30	OCT. (304)	7:46	75.9	27252	108:26	72.3	13523	A
FRI.	31	OCT. (305)	102: 0	89.5	27265	113:13	73.6	13537	A+J



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AMSAT-OSCAR 8 Operating Schedule

The spacecraft continues to provide communications capabilities in both modes A and J. Battery load tests during the month of July established that the batteries aboard the spacecraft are in good shape and the prognosis is good for the continuing operation of the spacecraft.

The following schedule is in effect at this time: Sunday (J), Monday (A), Tuesday (A & J), Wednesday (D or X), Thursday (A), Friday (A and J), Saturday (J).

The transponder parameters are as follows:

Mode	Beacon	Uplink	Downlink
A	29.402 MHz	145.85 - 145.95	29.4 - 29.5
J	435.095 MHz	145.9 - 146.0	435.1 - 435.2
D	Recharge Mode		
X	eXperimental mode; transponder scheduled for experiment		

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(continued from page 31)

Progress 8 (1980-24A) launched on 1980 Mar 27; initial orbit: 89.16 min, 51° 61, 242 km, 230 km; transmissions: 166.000 MHz, 922.750 MHz. Cargo and supply spacecraft; docked with Salyut 6 at 2001UT on 1980 Mar 29.

Cosmos 1170 (1980-25A) launched on 1980 Apr 1; initial orbit: 90.18 min, 70° 39, 383 km, 152 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1171 (1980-26A) launched on 1980 Apr 3; initial orbit: 104.89 min, 65° 84, 1033 km, 947 km; transmissions: none reported. Anti-satellite system target spacecraft.

Soyuz 35 (1980-27A) launched on 1980 Apr 9; initial orbit: 90.27 min, 51° 62, 314 km, 267 km; transmissions: none reported. Manned spacecraft (crew: Leonid Popov, commander and Valeri Ryumin, flight engineer) docked with Salyut 6 at 1516UT on 1980 Apr 10.

Cosmos 1172 (1980-28A) launched on 1980 Apr 12; initial orbit: 726.03 min, 62° 77, 40155 km, 608 km; transmissions: 2292 MHz. Early warning satellite.

Cosmos 1173 (1980-29A) launched on 1980 Apr 17; initial orbit: 89.59 min, 70° 31, 354 km, 155 km; transmissions: none reported. Recoverable reconnaissance satellite.

Cosmos 1174 (1980-30A) launched on 1980 Apr 18; initial orbit: 98.70 min, 65° 84, 1025 km, 362 km; transmissions: none reported. Anti-satellite weapon test against Cosmos 1171.

Cosmos 1175 (1980-31A) launched on 1980 Apr 19; initial orbit: 91.72 min, 62° 83, 460 km, 253 km; transmissions: none reported. Possible Molniya satellite failure or recoverable reconnaissance satellite.

Navigation Development Satellite 6 (1980-32A) launched on 1980 Apr 26; initial orbit: 707.73 min, 62° 88, 20232 km, 19628 km; transmissions: 1227.600 MHz, 1575.420 MHz, 2227.500 MHz. Global positioning system spacecraft.

Progress 9 (1980-33A) launched on 1980 Apr 27; initial orbit: 90.39 min, 51° 65, 350 km, 244 km; transmissions: 166.00 MHz, 922.750 MHz. Unmanned cargo spacecraft docked with Salyut 6 on 1980 Apr 29.

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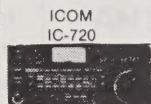
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The last frame of Telemetry received from the Phase IIIA spacecraft prior to lift-off. Note time of day display in top right corner.

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#0018 #0081
0 0 0 247 206 2

14:29:21

93	0	177	0	180	0	177	0	209	0	184	0	0	0	179	43
0	0	178	0	0	43	177	0	0	0	178	0	250	255	178	14
0	31	178	14	0	31	178	14	0	31	179	15	28	179	179	15
13	178	178	15	111	177	178	0	186	178	178	0	61	175	178	0

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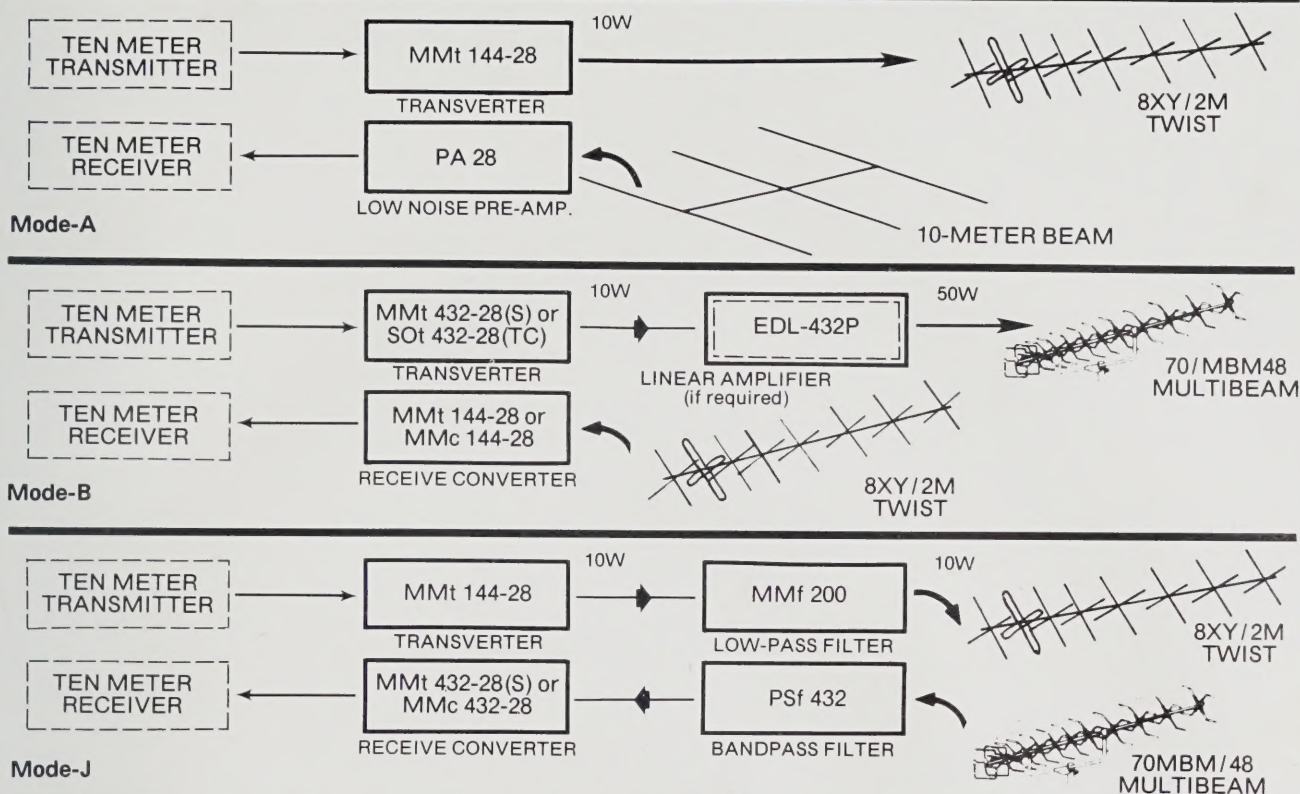
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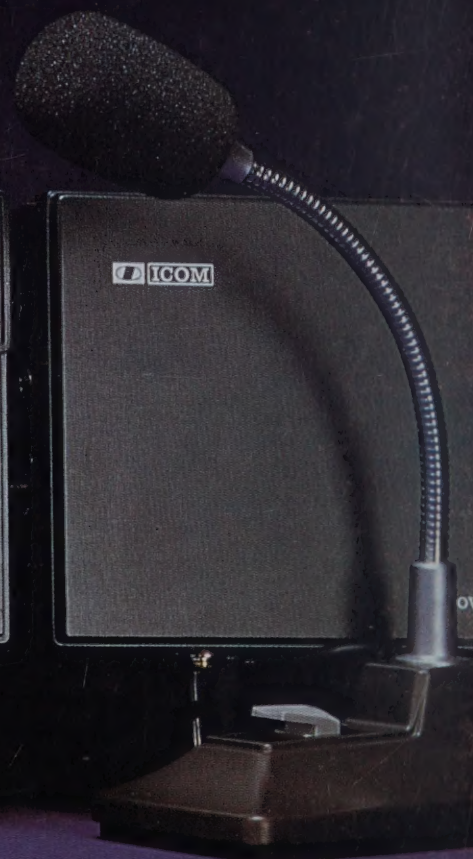
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